The science news monthly

SCIENCE DIGEST

MAY 1965 35 CENTS ICD

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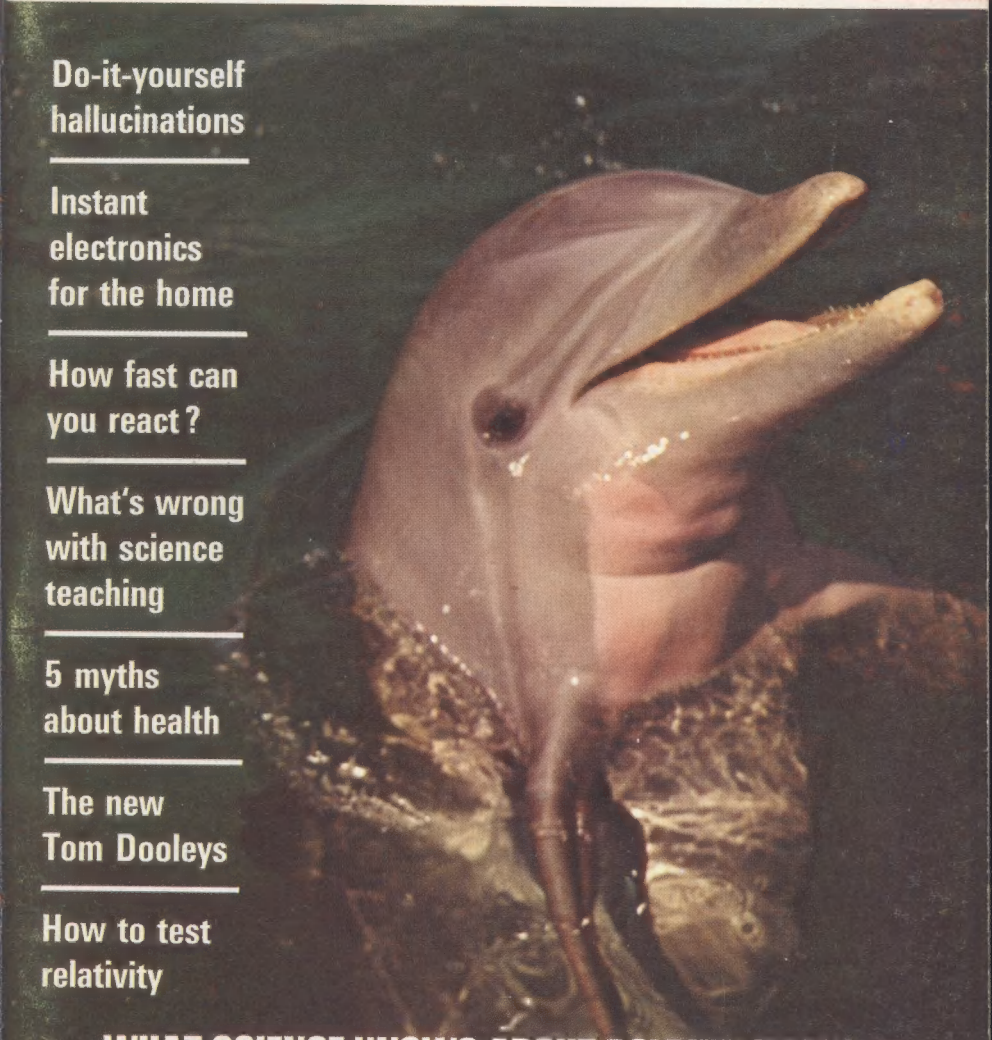

WHAT SCIENCE KNOWS ABOUT DOLPHIN 'TALK'

U. P. I. Photo

The Bible B. C.

INTERMINGLED with stones and earth, archaeologists digging at a site in Masada, Israel, recently found remarkably well preserved fragments of two biblical scrolls. One of the two scrolls discovered pertained mainly to the 33rd chapter of the Book of Deuteronomy; the other contains chapters 35 to 38 of the Book of the Prophet Ezekiel. It is believed that both had been deliberately hidden beneath the floor in the back room of a building assumed by Professor Yigal Yadin and his team of archaeologists to be an ancient synagogue. The scrolls were uncovered when the excavation team was digging under the floor of the ancient building to ascertain what it was used for in the time of Herod the Great (73 to 9 B.C.), the Roman king of Judaea.

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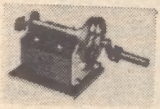

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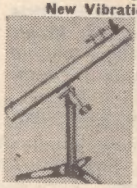

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WHAT do you talk about at the dinner table? Hugh Downs talks about noses among other things. Maybe you'll talk about them, too, after reading his account of a dinner-table discussion inspired by a teen-ager (see page 85).

We wager you'll be talking about a number of other subjects after reading this issue of *Science Digest*.

There are two we've been talking about with fascination here in our editorial offices while getting stories on them ready for publication.

THIS MONTH

One is the extraordinary intelligence of dolphins and their "talk." An impressive array of research studies is going on these days in that field—not just for the sake of curiosity (though that's good enough reason) but also to obtain data useful to human beings in building underwater instruments. Our report on the latest findings is on page 9.

The other subject concerns planarians or flatworms. These are the creatures that you multiply by simply cutting them up. A ruckus is going on right now over whether their tails have the same capacity to "remember" as their heads. We offer a report on that on page 20. There's also a review of a book on flatworms that has more to do with light-hearted science than with the long-hair variety (see page 88).

But if biology isn't your dish, check the contents page (opposite).

THE EDITORS

SCIENCE DIGEST

Twenty-ninth year of publication

The dolphin is probably the most intelligent animal on earth. For several years now, scientists have been exploring the possibility of "talking" to dolphins. For a progress report on what they have discovered, see page 9.

Photo: H. Davis (FPG)

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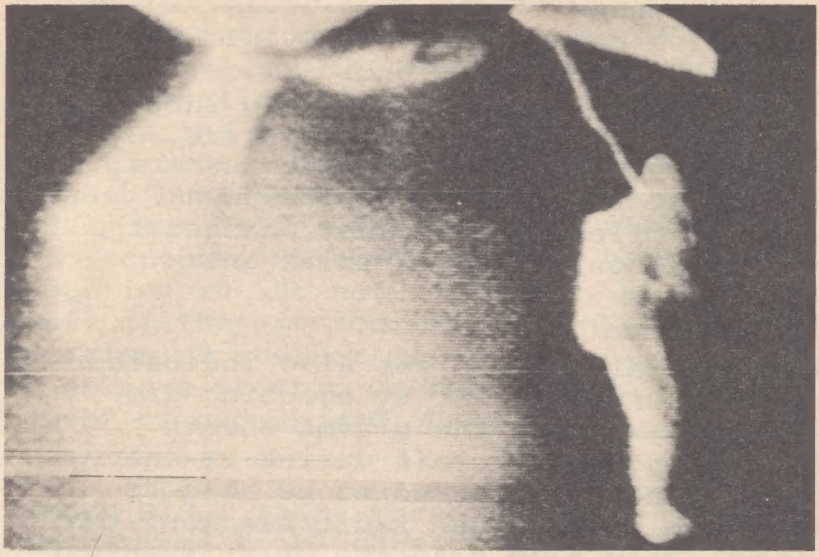
THE LATE SCIENCE NEWS

THE SPACE RACE: ROUND TWO: As American astronauts rehearsed their first multi-manned space flight, the Russians pulled off their second, with an added fillip that astounded the world. Aleksei A. Leonov opened a hatch on Voshkod 2 and stepped out into space (see the top picture, opposite page). Fastened to the space ship by a five-yard life line, he wore a pressure suit specially designed to withstand the void beyond our atmosphere and the sun's lethal radiation.

Apart from the drama of a man's floating in space all alone, the feat meant that Russia is again well ahead in manned space flight. She had kept her lead throughout round one, when the U.S. and U.S.S.R. developed their capability of sending one man orbiting the earth. In round two, multi-manned flight, the purpose is to work out techniques to rendezvous in space (a must for a manned trip to the moon). By getting a man safely out of a capsule and back in again, Russia got a head start. An American astronaut will open a hatch and stick his head out in the Gemini 4 shot, perhaps in June. But an attempt to go all the way out isn't planned until the Gemini 5 shot next fall.

The Soviet "walk" in space cast a pall over America's space effort, whose Gemini program was 18 months behind schedule. Virgil Grissom and John Young (below, opposite)



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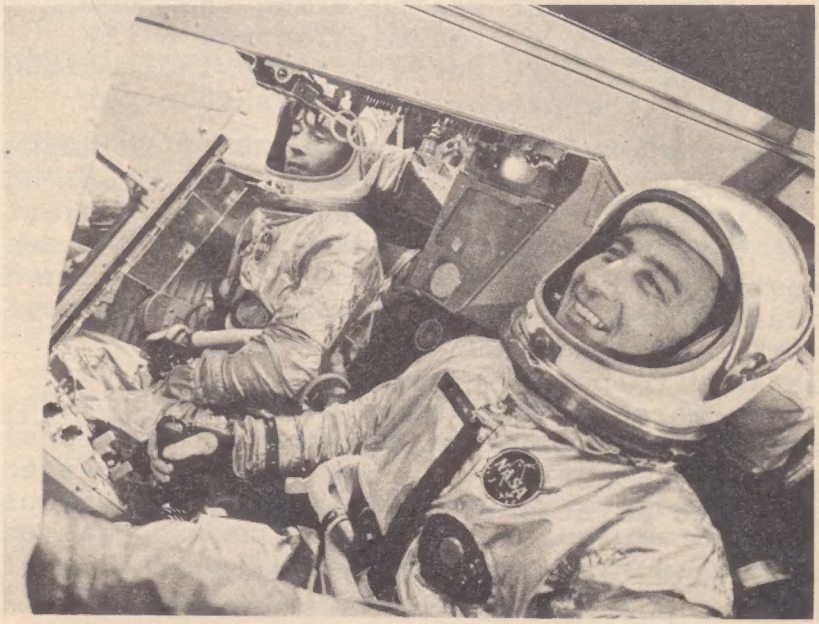


gave the U.S. a "first," however, in the initial manned flight of a Gemini space craft five days after the Soviet feat. By the time the three orbit flight ended Grissom had maneuvered the ship into a completely different orbital plane. By firing small rockets called thrusters, he brought the craft's apogee down from 142 miles to 105. That changed the elliptical path to a circular one.

Some initial success was also indicated in other experiments. By ejecting distilled water into the plasma sheath surrounding their craft during re-entry, the astronauts appeared to be able to penetrate some of the radio blackout that occurs. They also used the craft's thrusters to bring it into a low orbit before the retro firing that was to bring them down. Another aspect of the mission was a try at "controlled re-entry". First indications were that the attempt was less than perfect; the craft landed 50 miles off target.

The thrusters that gave the mission its most significant success, by changing the craft's orbit, form a system called OAMS (orbit attitude and maneuver system). It is able to perform translation maneuvers along three axes and can even be used as a means of slowing down the ship for re-entry. The ability to "steer" a spacecraft is vital to an attempt to achieve a rendezvous.

Meanwhile, the last of the Ranger series made a perfect hit on the moon.

CRIME DATA DISPUTED. Widely quoted F.B.I. statistics which show a rapidly climbing crime rate and indicate a general breakdown in public morality are being sharply challenged by prominent criminologists and sociologists. No one doubts that the total number of crimes has increased but the scholars say that the F.B.I. has failed to take many factors into account, which would tend to show a reduction in the national rate. At the heart of the emotion-filled dispute is the question of whether the nation is in serious trouble or merely in a normal period of growth and change.

FINGER SIGHT FAKE. Three Russian women who claimed to be able to see colors and read newspapers with their fingertips have been exposed as clever fakes. The cheating was made known in an article in the Soviet newspaper Literaturnaya Gazeta.

COLOR BY TOUCH DEFENDED. Richard P. Youtz, psychology professor at Barnard College, insists that an American housewife really has the ability to distinguish color with her fingertips, despite the Soviet fake (see Science Digest, April '64).

PSYCHOLOGICAL TESTS FOR INSURANCE. Auto insurers are beginning to use lengthy psychological tests in an attempt to discover motorists with aggressive, antisocial personalities. Psychologists believe some personality traits are major factors in causing auto accidents.

TROUBLE WITH F-111. The F-111, pivoting-wing plane (formerly called the TFX) has run into technical troubles. How serious the problems are project directors are not saying, but any major problems would be extremely worrisome since the plane is intended to be the backbone of U.S. fighter forces before 1970. Problems are normal in any project of this size, but the F-111 was so carefully refined and wind-tunnel tested that engineers expected fewer troubles than they have had.

ADHESIVE TOOTH FILLINGS. Dental researchers have developed new materials for filling cavities that may utimately result in less drilling and less filling. Now dentists have to make a cavity wider to assure a firm grip for the filling. With the new materials dentists may just have to clean the cavity and rely on the material's natural adhesiveness to keep it in place. The material will also stick flush to the tooth surfaces and stop the seepage of mouth fluids under filling edges--a major cause of decay in old fillings. However, it is still too early to tell how long the materials will retain their adhesiveness.

QUOTE OF THE MONTH: "I did not experience any fear, only a sense of the infinite expanse of the universe. . . .I knew I would not meet anyone I know up there." Russian Cosmonaut Aleksei Leonov when asked how he felt when he became the first man to step out into space.

What science knows about dolphin 'talk'

Curator of fishes at Marineland of the Pacific records dolphin's "words."

by Andrew Hamilton

On the northern coast of New Zealand a few years ago, a playful dolphin appeared inside Hokianga Harbor. Promptly named "Opo," it seemed to have a grin on its face as it bumped beach balls around in the water, let bathers pat it on the head, and even allowed one 13-year-old girl to ride on its back. While in the company of humans, it chirped and whistled.

Those chirps and whistles have recently been the subject of intense research that could be as significant as it is fascinating.

Doing research on Pacific bottle-nose dolphins under a Navy contract, Dr. John Dreher and William E. Evans of the Lockheed-California Company have reported 32 patterns of dolphin whistles. Nearly identical sounds are made by Atlantic bottle-nose dolphins and Pacific pilot whales, a related species.

And at the Communications Research Institute in Miami, Florida, Dr. John C. Lilly has found that dolphins sometimes try to vocalize human speech—and even scold. One dolphin responded to Dr. Lilly's voice so readily that Mrs. Lilly, who was assisting in the experiment, laughed out loud. Whereupon the dolphin tried to laugh as well.

Since the early Greeks and Romans, it has been known that dolphins (warm-blooded, air-breathing mammals, not fish) could execute whistles, chirps, tweets, mews, clicks, rasps and barks. Aristotle wrote that when a dolphin is taken out of water "it gives a squeak and a moan in the air." Pliny the Elder

Seamen tell many tales about the concern of dolphins for people. Greek legends relate how drowning sailors were rescued by dolphins.

said, "For a voice they have a moan like a human being."

But are such sounds merely the expression of a mood (like the twitterings of a bird) or a warning signal (like the bark of a dog)? Or are they a rudimentary language, an attempt to communicate a complicated idea? Do dolphins sometimes actually try to talk to human beings?

Answers to these intriguing questions are being sought by scientists all around the world—in the United States, Italy, and Japan. Also the Russians are thought to be engaged in dolphin-talk research because underwater communication is important to national defense.

Outside man, dolphins are perhaps the world's most intelligent creatures. An average-sized dolphin's brain weighs 3.5 pounds, while a man's weighs 3.1 pounds and a chimpanzee's, .75 pounds. But there is considerable variation of body weight between a 300-pound dolphin, a 150-pound man and a 110-pound chimp. In brain-to-total-weight ratio, the dolphin still does fairly well: 2.1 percent for man, 1.17 percent for dolphins and .70 percent for chimps.

Sea captains and sailors have many stories to indicate the intelligence of dolphins—and their concern for human beings.

Several Greek legends tell of seamen washed overboard who were supported by dolphins and brought safely ashore. At the turn of the century, a famous dolphin named "Pelorus Jack" regularly met and accompanied ships that crossed Cook Strait between the two main islands of New Zealand. A few years ago in Florida, a woman bather was dragged down by an undertow. "Someone gave me a tremendous shove up on the beach," she said later. "When I turned over nobody was near, but in the water a dolphin was leaping about."

Dolphins are quick to learn. One of Dr. Lilly's creatures learned to push a "yes" switch after only a few tries. A monkey took a hundred random tries to find the right switch. Dolphins easily learn such tricks as jumping through hoops, playing "basketball" and carrying sticks from one end of a pool to the other.

There's also a well-developed sense of humor in dolphins. They have been seen to sneak up behind a pelican and snatch a feather from its tail. They have teased turtles by rolling them end-over-end with their flippers. One dolphin put pieces of squid near a grouper's rock cranny; then when the fish came out, the dolphin snatched the bait away.

Dolphins are emotional crea-

tures, too. At Marineland of the Pacific near Los Angeles, Bimbo, an 18-foot pilot whale, stopped eating and became aggressive toward smaller dolphins in his tank. David H. Brown, curator of mammals, reasoned that Bimbo's ego needed bolstering, and so decided on a drastic cure. He drained the tank to the three foot level. Bimbo began to whistle piteously, and soon all the dolphins gathered around—comforting him with soothing conversation. After several minutes, the tank was refilled; Bimbo's manners and disposition improved immediately.

Two "voices" of dolphins

Dolphins seem to use their "voices" in two ways:

1. *Talk*—the chirps, tweets and whistles that have been known since ancient times are thought to be communication between themselves and other creatures.

2. *Sonar*—certain harsher sounds such as rasps and clicks are echo-ranging techniques to avoid underwater obstacles or to locate food.

Some scientists speculate that dolphins talk among themselves. In 1962, Dr. Dreher and Evans were aboard the research vessel *Sea Quest* about 300 miles south of San Diego. Their primary mission was to study the California gray whale, and they had strung a number of vertical aluminum poles inside Scammon's Lagoon.

Suddenly, five Pacific bottlenose dolphins appeared about 500 yards from the barrier. Hydrophones picked up their whistling chatter as they drew together. Then a scout left the group, swam over and inspected the poles. More whistles and more dolphin talk. After a few minutes, the consensus seemed to be that the poles were harmless, so all five swam past the poles.

According to Dr. Irving Bengelsdorf, science editor of the *Los Angeles Times*, "a whistle language exists. This is not too strange when one considers that there are several human communities which communicate by whistling. The Mazateco language in Mexico, for example, consists of a series of whistles."

Dr. Lilly has perhaps done more than any other scientist to solve the mystery of dolphin talk. Since the middle 1950's, he has run a series of experiments in which he has found that dolphins make sounds similar to those of human beings. He calls these sounds "humanoid emissions."

Such talk was produced by a reward system. Dr. Lilly or one of his assistants would shout a word, or a series of words, over the surface of a tank. The dolphin would raise its blowhole out of the water and answer—sometimes with a single word, sometimes with three or four. Its reward for "talking" would be a fish.

Dr. Lilly is cautious about labeling this interchange as true conversation between dolphin and man. "About 10 percent of these emis-

Nobody has been able to "jam" a dolphin's sonar. The dolphin is not deceived by phoney sound waves broadcast into his tank to confuse him.

sions sound like human speech," he has said. "How much is instinctual and how much is not we have no way of knowing at the present time. It may take 20 years or more to develop good answers."

The first indication that dolphins possessed a built-in sonar system—the capacity to project a burst of energy, bounce it off an object, receive it back and judge distance, size and composition —was first suspected in the 1940's. Arthur McBride, then curator of the Marine Studio Oceanarium in St. Augustine, Florida, noted the fact in his marine journal.

McBride had tried to catch dolphins in Florida's Intercoastal Canal. Even though the waters were murky, the animals easily eluded nets that had been set for them. The smaller the mesh, the easier it seemed to be.

Later, another researcher, William Schevill of the Oceanographic Institute at Woods Hole, Massachusetts, hit upon the reason. The nets had been dried in the sun. When placed in the water, masses of tiny air bubbles escaped toward the surface. Schevill reasoned that the dolphins bounced echo-ranging signals against the bubble curtain and were thus warned of the trap.

Meanwhile, bits and pieces of information were accumulating to indicate that dolphins, in addition to being sociable, communicative and intelligent, possessed an extraordinary sonar apparatus. In fact, it is more sophisticated than any system man has been able to manufacture.

Hearing capacity

Schevill and Dr. Winthrop Kellogg of Florida State University showed that dolphins possess a hearing capacity far beyond man's ability and well into the ultrasonic range. Whereas man's range extends up to about 24 kilocycles, the dolphin can hear up to 80 kilocycles —and possibly beyond. When hydrophones were placed in the water, the usual chirps and tweets were detected. But there were other strange sounds—like the creaking of a rusty hinge or a series of sharp clicks. This was the sonar beam.

In further experiments, Dr. Kellogg demonstrated that a dolphin could locate underwater passageways through a barrier, detect small, sinking objects thrown in the water and discriminate between two sizes of fish. Dr. Kenneth Norris of UCLA demonstrated that dolphins could navigate with their eyes covered with rubber cups.

Just how does dolphin sonar work?

First of all, it should be understood that a dolphin has no vocal

cords. This is how dolphin clicks and rasps are produced:

The animal breathes in air through a blowhole in the top of its head, and the air then travels to the lungs. When the dolphin wishes to echo-range, it forces air into sacs in its head, closes some valves and forces the air past them. The clicking and rasping sounds that result are made up of high and low-frequency waves resonated and directly beamed by two horn-shaped sacs.

The sonar signals emerge in a cone-shaped beam, taking in everything parallel to the animal's jaw and slightly above its head. As the dolphin moves toward its target, it swings its head back and forth in a scanning motion.

How is the echo received?

Dr. Norris says that a dolphin has ears buried in its head and an extremely large and thick acoustic nerve—thus giving it a highly-developed sense of hearing. Some of the whistles and clicks are heard directly by the ears. But Dr. Norris speculates that a dolphin's jaw may also serve as an "antenna" to pick up ultrasonic sounds.

Thus it is possible that a dolphin "speaks" with its forehead and "hears" with its jaw.

The dolphin's built-in sonar system has two advantages which man-made sonar devices hope to emulate. Almost all our sonar systems use pure tones, while the dolphin's signals are mixed into high- and low-frequency components. High-frequency waves afford very accurate feedback information. The dolphin is also able to directionalize its sonar beam, which almost all man-made systems do not.

Another interesting fact: Nobody has been able to "jam" a dolphin's sonar. Sound waves believed to be similar to those projected by dolphins have been broadcast into a tank in an attempt to confuse the animals. But the dolphins swim merrily on their way.

Early in World War II, United States cryptographers cracked the Japanese code—thus allowing our admirals and generals to gain valuable knowledge that led to ultimate victory. If science can decode dolphin talk and find a way to communicate with these friendly creatures, it will be a scientific victory of the first magnitude.

And if we learn the secrets of dolphin sonar, we can improve our anti-submarine warfare defense tremendously.

Not long ago, the scientist Leo Szilard wrote a short story entitled "The Voice of the Dolphin." It described a group of scientists who learned to communicate with dolphins and taught them mathematics, physics, chemistry and biology. Some of the superior dolphins even went on to win Nobel prizes.

We haven't yet reached this advanced stage of communication with the friendly dolphins—and probably never will. But it has been suggested that the reason dolphins always seem to be grinning is that they understand our language and are patiently waiting for us to learn dolphin talk.

The domesticated dolphin

As the dog and the horse helped man in his conquest of the land, so the dolphin (or porpoise) may help him in his conquest of the sea.

The day that dolphins can be used to place scientific instruments under water at man's command, or help locate sunken ships, has been brought a step closer by a University of California scientist working on the island of Oahu, Hawaii.

Writing in the journal *Science*, Zoologist Kenneth Norris described how he took a trained bottlenose dolphin out into the open sea and worked with it for seven days. Although the dolphin could easily have escaped and joined a herd of wild dolphins, it returned each night to an underwater wire cage. While it was on the loose, Dr. Norris was able to control the animal's movements by means of underwater sound signals.

The young male dolphin used in the experiment was called Keiki (Hawaiian for child). It was caught early in 1964 in the sea off Oahu.

Like most dolphins, Keiki adapted readily to captivity. He was then trained to respond to the sound of a whistle. A correct response brought a reward of food.

When first taken into the open sea, Keiki seemed fearful. Dr. Norris noted that captive dolphins are usually afraid of unfamiliar situations. He believes that this may be

Camera Hawaii

Keiki is photographed swimming in the open sea. Every night, he returned to his cage.

one of the reasons that Keiki returned so readily to his cage every night.

Another probable reason is that Keiki had become accustomed to the type of food the scientists gave him. Captive dolphins often become habituated to a single type of food to the exclusion of all others.

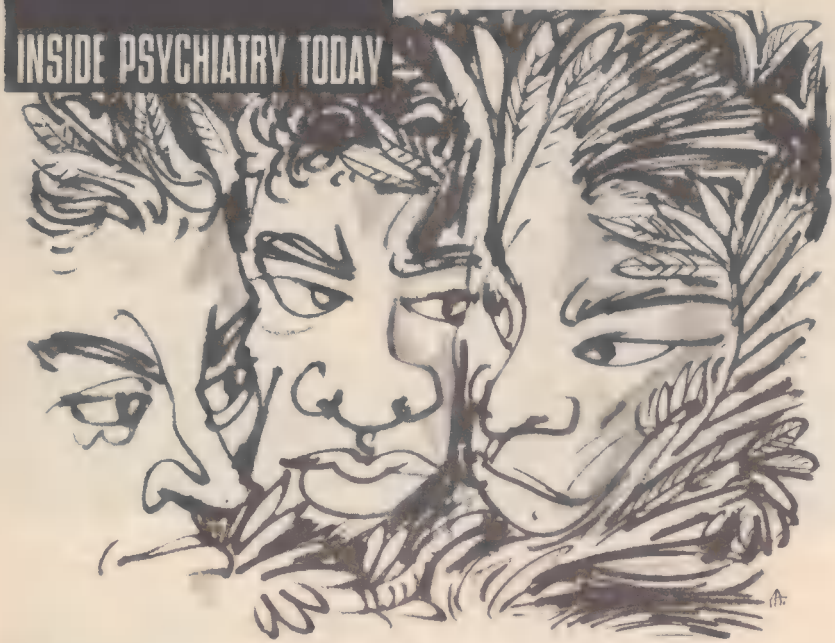
Social ties

Keiki was unwilling to escape perhaps because of the social ties that often develop between scientist and dolphin. Dolphins are very social animals and, when isolated, their health will suffer. During the training period, scientists had to spend about an hour a day swimming around with the dolphin.

"Keiki quickly became very tame and solicited bodily contact of various sorts from the swimmer," says Dr. Norris. "Porpoises frequently stroke each other with their flippers. The members of the investigating team often responded to Keiki's solicitations by stroking and patting him during and after the work sessions. It is possible that this bodily contact constitutes a reward for which the presence of human beings becomes a conditioned reinforcing stimulus, increasing the probability that the animal will stay near people under most circumstances."

Concludes Dr. Norris, "It may prove possible to insinuate a trained animal [carrying scientific instruments in a harness] in schools of wild animals and to observe and record various kinds of behavior. Such animals could also be used to perform a variety of human-directed tasks in the sea."

INSIDE PSYCHIATRY TODAY



The not-so-happy Hawaiians

by Flora Rheta Schreiber and Melvin Herman

HAWAII, a potpourri of many cultures, shows that society has a pronounced effect on the incidence of mental illness.

The point became sharply evident recently in a symposium on Cross Cultural Problems in Psychiatry held in Honolulu. In Hawaii, the psychiatrists were reminded, every one is in a minority group. The white Anglo-Saxon Protestants are only a small part of the Caucasian minority, which in turn constitutes just one third of the population. The Japanese make up another one third. Hawaiians account for only twenty percent of the population. The pure Hawaiians, a disappearing group, number only five thousand. Other minorities comprise the remaining thirteen percent.

The shifting in manners and morals caused by the influence of one culture on another, according to Dr. Kwang Yen Lum, a Honolulu psychiatrist, creates a chronic state of conflict.

The early New England missionaries, a sternly moral group who contrasted sharply with the free and easy Hawaiians, imposed a strict code which is still the dominant official ethical tone. The missionaries enveloped the naked bod-

ies of Hawaiian women in Mother Hubbards which the Hawaiians have long since converted into the beautiful Hawaiian Muu-muu. The paradox is that for over one hundred years Hawaiians have lived with a New England conscience planted within a Polynesian body.

Another group of New Englanders, the whalers, left a completely contradictory imprint on island mores.

The second generations of both these groups were well on their way to establishing families representing the inner core of wealth and respectability.

Though immense fortunes were being made in their midst, the Hawaiians simply had no competitive spirit. Polynesian life is easy-going. The people don't measure by financial success. They stress the importance of becoming a man, of showing maturity in getting along with their neighbors, of being skilled at fishing and manly sports.

Their goals in life are very different from those of the Japanese and Chinese, who also rose to high positions in two generations.

In the competitive society of today, there are many "marginal men who stand between the two cultures, Polynesian and American," says Dr. George Schnack, consultant to the Juvenile Court of Honolulu. "They become angry people who cannot control their behavior at all times." Among all the conglomeration of names on the islands, Hawaiian names appear in greater numbers on prison and corrective institution lists.

The Polynesians lived traditionally by a system of taboos which was demolished by the missionaries. Men who consider themselves pure Hawaiians are kept by pride from getting into trouble, but the part Hawaiian often lands in jail for anti-social behavior.

A great temptation

At the same time, the free and easy life of these attractive people is a great temptation to young people coming from more rigid cultures. The Hawaiian members of the young crowd are apt to be leaders in many ways. Beyond that, many of the young people from Chinese and Japanese families are finding it hard to identify with their parents' old-world culture.

Dr. Robert Kemble, Director of Queen's Hospital Mental Health Clinic in Honolulu, reports that some of his patients literally cannot communicate with their Japanese-speaking parents. These are boys and girls who only speak English because they either didn't do well at the Japanese afternoon schools or refused to attend. "Society does many brutal things to teenagers," says Dr. Kemble, "but none worse than depriving them of a definite place and role. These problems are highlighted in Hawaii because of the difficulty of passing from the cultural world of one's parents to the cultural world of one's peers."

Ten years ago, the delinquency

rate among the Japanese population was almost negligible. Today it has increased by 20 per cent, a sharper increase than any other group. The old rigid adherence to parental authority has been superseded by adolescent rebelliousness.

From all these groups are coming a great many dislocated adolescents. The cultural gap between the children's world and the parents is too great. The children are becoming part of the American world. Their parents adhere to the minutiae of the Japanese way of life. The two ways of life are so different that it is hard for the children when they can't turn to their parents for understanding.

The youngster of a group whose family structure has been traditionally rigid may find himself lost when he comes under the influence of leaders of his peer group who have feelings that good social behavior is to have a good time. Probation officers mention that many of the Hawaiian families have no remorse over getting into trouble. They fight the courts, don't cooperate with the police, in fact go against the law. Dr. Schnack notes a "failure to develop any conscience."

Different patterns of life among the groups develop at a very early age. Part Hawaiian children live an unstructured life. Dr. Schnack tells of their "unique system of temporary adoption. A child who is dissatisfied at home can just pick himself up and go to a neighbor or even another family on another island. The elected family accepts him, for everyone loves kids. When the child is tired of his new family, he can go back to his original family." Many people in this group have several family names for this reason. They don't know who they are legally and are often quite confused.

In the symposium held in Honolulu recently, Honolulu physicians testified that these social conflicts create illnesses in all the different groups and in a different way in each.

Substitute children

Interesting revelations as to what happens to a child born to parents who have lost a child before the new baby's birth come from the Children's Psychiatric Hospital, University of Michigan.

The new child, born into a world of mourning focused on the image of the dead, starts with an emotional liability. He must cope with parents who have conceived a child as soon as possible to replace the last one. The living child thus becomes a substitute for the dead child to whose loss the parents' reaction was severe and unrelenting. The parents impose the identity of the dead child on his substitute. Their expectations, hopes and demands are modelled on an ideal-

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Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

ized image of the dead child so that the living child must compete with an image. It is a ghoulish kind of sibling rivalry.

Moving-day blues

Forty million Americans move each year. In doing so, they think about the neighborhood, the rent, and layout of rooms, yet overlook the fact that every move carries with it the prospect of an adjustment involving the reorganization of the whole personality. Dr. Robert E. Switzer of the Menninger Foundation says, "These moves affect the mental health of individuals in many ways."

For one thing, he indicates a feeling of family instability is almost inevitable. There is even the possibility of an actual family breakdown.

Moving into a new community, whether that community is socially and economically above or below the neighborhood left behind, presents emotional hazards. To develop a sense of belonging to the new community, to make it one's own, is taxing and may not come either naturally or swiftly. To feel at home calls for a deep emotional involvement and one cannot have this involvement with what is unlived in and devoid of memory and associations. The result, almost inevitably, is a feeling of isolation.

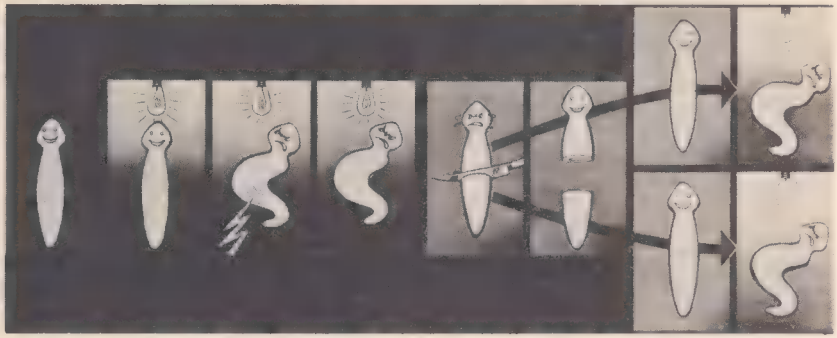
This feeling grows more intense when the move is upward on the social ladder because of the family's own improved financial status, What comes into play for such families often is a feeling of social inferiority. Emotionally unable to make identification with the new group, the family may feel rejection where none actually exists.

Still, there is frequently prejudice against newcomers. The newcomer in Biblical times became the stranger represented by Ruth among the alien corn. And every schoolboy can tell you what it means to be the new boy in a class where all the other kids know each other well. In towns such as those near air bases, where there has been a sudden influx of population, prejudice against newcomers has been very evident. For the newcomers threaten the town with change, with overcrowded schools, less parking space and the whole lexicon of possible inconveniences.

Dr. Switzer, who is Director of the Menninger Foundation's Children's Service, has a few special remarks on how moving affects children. "Young newcomers to a city," he says, "suffer, at least temporarily, an impairment in the capacity to adjust to the new home, school and to making friends." He adds, "Parents planning to move to a new location should especially consider the emotional stability of their child. They should look carefully at their relationship with their child and make themselves more available to him before and after the move. The child's need for personal relationships in the new community should not be overlooked."

THE BIOLOGY STORY

The tail that 'remembers'



The planarian demonstrates how acquired learning can be transferred to a second asexual generation. The second-generation worm inherits the original worm's classical conditioning.

THE learning abilities of the planarian, a common freshwater flatworm, has become the subject of a spirited scientific controversy.

Planarians are one of the lowest forms of animals with a true central nervous system and would seem an unlikely subject for learning experiments. But a group of experimental psychologists at the University of Michigan, led by Dr. James V. McConnell (see page 88), have made a series of remarkable studies of these highly unorthodox research animals.

The worms were conditioned to respond to a flashing light. Then they took advantage of the planarians' astounding regenerative ability. A planarian can be cut in half and grow a new complementary half—a new tail for the old head and a new head for the old tail.

When an "educated" worm was cut in half and allowed to regenerate, the old head retained a good portion of its former training. This was no surprise. What was surprising was that the old tail also retained some "memory."

Trained worms fed to untrained

In a further test, trained planarians were chopped up and fed to untrained planarians. The untrained planarians then showed some signs of the training of the animals they had eaten.

These experiments suggested that learning was not centralized in the brain, but that it produced changes throughout the entire body.

Nobel-prize-winning biochemist Dr. Melvin Calvin of the University of California became interested in the experiments and organized a

research group of his own to repeat the planarian experiments and investigate the chemical nature of learning.

Response consistent?

However, Calvin and his associates were unable to obtain a consistent enough response from the worms to feel that they had properly learned anything.

Dr. Calvin and Dr. Edward L. Bennett published an article in a recent edition of the *Neurosciences Research Program Bulletin* entitled "Failure to Train Planarians Reliably." They described how they followed Dr. McConnell's methods but came up with unsatisfactory results. The California scientists doubted the usefulness of the planarians in learning studies.

A further complication arose when a version of the Calvin-Bennett paper was submitted to *Science,* the official publication of the American Association for the Advancement of Science, and rejected by the editorial board "for a combination of demerits."

Dr. McConnell believes that the heart of the controversy is a definition of learning. He feels that Drs. Calvin and Bennett's "unsuccessful" results were successful.

The California group set a criterion of 18 correct responses out of 20 consecutive flashes. Nine of the 14 test animals achieved this criterion. Drs. Calvin and Bennett, however, did not feel that 65 percent success is a reliable evidence of learning.

Dr. McConnell said his group got similar percentages of successful subjects. Thus he feels that both his own results and Dr. Calvin's indicate that learning occurred.

When the head of a planarian is split straight down the middle, each half will regenerate into a completely new head.

A two-headed planarian takes a shorter time to learn than one-headed worms. Controversy rages over its learning abilities.

INVENTIONS PATENTS PROCESSES

Instant electronics for the home

A new concept in do-it-yourself electronics is called "IRectronics," a line of electronic "building blocks" which forms 20 low-cost systems for various home and outdoor uses.

A LINE of new electronic "building blocks" now allows you to construct a public address system or an electronic "baby sitter" at home. The only tool you need is a screwdriver.

This is made possible through a new concept in do-it-yourself electronics called "IRectronics," a line of electronic "building blocks" which form 20 low-cost systems for home, boating, outdoor and automotive use. All units operate from batteries or the standard home electrical outlet.

The line is made of 25 compatible, solid-state modules, sealed in clear plastic, and 19 accessories for a variety of uses.

"IRectronics" was conceived and manufactured by International Rectifier Corp., El Segundo, Calif.

Robert J. Mueller, IR's Distributor Division manager, says that one of the biggest stumbling blocks to a more widespread use of electronics in the home is the drudgery and technical ability associated with the assembly and soldering of electronic kits.

"We have avoided the kit approach with this line by doing away with any soldering, and reducing assembly requirements to the matter of tightening a few screws."

According to Mueller, the do-it-yourselfer can realize a 5- to 20-percent saving on his system when compared to a ready-made product.

Costs of the systems range from

$4.95 for a danger blinker to $19.95 for a walkie-talkie. The finished system's purpose can be easily expanded or changed by adding or substituting one or more "blocks."

The "IRectronics" line will be sold nationally through electronic suppliers, department stores, supermarkets, hardware stores, automotive suppliers, camera and hobby shops and other retail outlets.

Pocket heart pacemaker

A new kind of artificial cardiac pacemaking unit, which stimulates the heart by means of a recurrent electrical signal induced in an implanted coil from an external coil, is now available commercially in Britain.

A redesigned version of equipment first developed four years ago, it is believed to be one of the few in which the patient carries the "pacemaker" outside the body. Other techniques implant a pulse generator inside the chest wall.

The new version of the equipment is powered by a replaceable 1.5-volt dry cell, and the pulse generator unit is light and small enough to carry in a pocket or in a belt around the abdomen.

The cardiac pacemaker consists of a simple 2½" diameter coil encapsulated in silicone rubber, and a small, robust battery-operated pulse generator connected to a primary coil by a flexible lead.

The secondary coil is implanted in the chest. The stainless steel leads of the coil, covered with loose silicone rubber sleeves, are secured in the heart muscle.

The pulse generator unit can be carried on a belt or in a pocket. It has recessed controls, enabling the rate to be varied, and an audible tick which can be switched on when required. An internal pre-set switch enables the unit to be operated at high or low power at the discretion of the medical advisers, to allow for increasing threshold over a period of time.

The unit is powered from a single U2 dry cell (1.5 volt) that is available internationally. The life of the battery is given as between one and four weeks, depending upon operating conditions. Pulse power from the unit remains constant during battery life, need for battery replacement being indicated by a reduction in rate.

The equipment may be obtained from Joseph Lucas Electrical Co. Ltd., Great King Street, Birmingham, England.

Microwave amplifiers that operate at the highest frequencies and with the widest bandwidths of any integrated circuits have been developed by Bell Telephone Labs. Below: A technician fabricates the basic amplifier circuit by vacuum deposition.

Solving the garbage explosion

Every 60 seconds, people in the United States drop 251 tons of trash into their garbage cans. At the end of the day, 362,000 tons of trash have accumulated.

We are approaching a time when, according to the official journal of the U.S. Public Health Service, "the well-known capacity of the modern city to drown in sewage is more than matched by its talent for smothering itself under a blanket of garbage and refuse . . . ."

To help meet the problem, Westinghouse Electric Corp., of Pittsburgh, Pa., and SACS of Shawnee, Okla., recently announced a disposal method to reclaim trash and garbage rather than destroy it.

The disposal operation takes place in "light industrial" plants which salvage marketable items—metal, glass, paper and rags—and process the remaining material into a soil-conditioning compost. Since the operation doesn't involve fires, there are no odors or smoke. There is no attraction for flies or rodents because the plants are completely enclosed.

The first step in the Westinghouse/SACS process is a receiving station where collection trucks dump their unsorted refuse into a conveyor hopper.

The refuse is then moved to the salvage section where marketable materials are removed and segregated. The remaining matter then enters a pulverator and grinder where it is moistened with added water, ground up and fermented with its own fungi, molds and bacteria for six days until a good quality compost results.

Besides the fact that everything a salvage-compost operation produces is useful, with no ash to be carted away, there is also another benefit possible: Sewage sludge can be used to moisten the material that is to become compost.

The pollution-free plants can be located in the heart of metropolitan areas. Such a plant has been operated in San Fernando, Calif., for a year and a half, handling 90 tons of refuse every day. New plants can be designed to handle daily capacities of 35 to 2,000 tons.

Seagoing computer

An electronic computer is lending a helping hand to sailors and scientists aboard a research ship sailing on a 10-month voyage to the Indian Ocean and beyond.

The research vessel is the Atlantis II, operated by the Woods Hole Oceanographic Institution of Woods Hole, Mass. She is manned by a ship's company of 25 crew members, 28 scientists and a computer. The computer not only collects oceanographic data, but also helps navigate the ship, using a new navigational system that makes use of the signals from orbiting earth satellites.

The purpose of the round-the-world expedition is to chart cur-

rents, take a census of tiny marine life, probe the ocean floor and unravel the sea's mysteries. The Indian Ocean phase of the voyage is part of a 23-nation experiment sponsored by UNESCO, in an effort to help nations of the Middle East increase their food supply by using the resources of the Indian Ocean.

The computer takes over in navigating the ship when an extremely accurate position is needed by the scientists. Three navigation satellites orbited by the U. S. Navy supply the signals.

When it is not navigating, the computer is busy doing a variety of scientific chores. Among its more important assignments is the juggling of data on salinity, temperature and currents of the ocean. The computer makes it possible for many types of readings to be taken continuously and, by means of printed symbols and a television-like screen, it gives immediate answers to questions relating to the data.

Part of a PDP-5 computer is swung aboard the Atlantis II, 210-foot research ship, which is cruising the Indian Ocean and beyond with a 25-man crew and 28 scientists.

Lightweight clamp-on-light provides 15,000 candlepower spotlight that enables arc welder to view work area with protective mask and eye shade always in place.

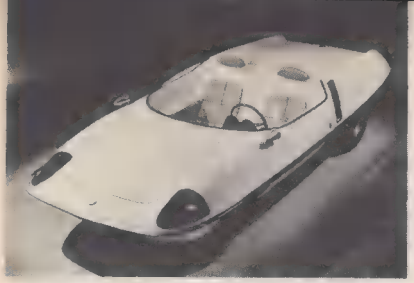
Two-piece plastic car

The country's leading manufacturer of ABS (acrylonitrile-butadiene-styrene) has gone into the automobile business.

Marbon Chemical Division of Borg-Warner Corp, Washington, West Virginia, has developed a sports/racing car with a two-piece plastic body.

The body consists of top and bottom halves formed in 15 minutes each from solid Cycolac ABS sheets. The top half has formed-in-place bucket seats, console for shift lever and secondary instruments, and arm rests. Fenders and wheel wells are an integral part of the bottom half.

Rustproof and virtually damageproof, the body was formed in a double-platen hydraulic press. Radiant heat at 250 degrees Fahrenheit was applied to the single sheet of Cycolac for six and a half minutes to form each half. The aluminum-filled epoxy mold then was drawn downward into the resilient plastic. The depth of the draw in



Car with two-piece, all-plastic body is being road-tested to evaluate potential of thermoplastics in manufacture of autos.

some sections was as much as 30 inches. Held to the mold by vacuum, the material hardened into the body shape during a seven-minute cooling period.

The manufacturer says the forming dies for the vehicle cost less than $30,000—less than 10 percent of the cost of dies for a fiberglass body.

Breakthrough in chemistry

New drugs and dyes, in fact an entire new area of chemistry, may result from recently patented compounds.

The compounds are called "stable borons" or boron-hydrogen compounds. They were patented by Drs. Henry C. Miller and Earl L. Muetteries of the Central Research Department Laboratory of E. I. du Pont de Nemours & Co.

So far, no commercial products have been developed from these compounds, but du Pont scientists look upon them as a base from which many useful synthetic chemicals can be built.

The stable boron atom contains 12 boron and 12 hydrogen atoms. To create new chemicals, chemists replace some of the hydrogen atoms with other atoms.

For 100 years, chemists have been using benzene and hydrogen compounds as a base to create a variety of new materials. By replacing hydrogen atoms in the so-called "benzene ring," they have been able to develop DDT, plastics and many other useful industrial chemicals. Chemists hope to make the same sort of use out of the "stable boron" compounds.

How to remove Strontium 90

Federal researchers have proved a pilot-plant method that commercial dairies can use to remove Strontium 90 and other radioactive substances if these potentially hazardous elements ever imperil our nation's milk supply.

The process is highly effective and adds an estimated 1¢ to 2¢ per quart to milk cost. Experts say the flavor of the treated milk is comparable to untreated milk.

The process involves ion exchange processing of milk through a fixed resin bed.

The project was carried out at the Agricultural Research Center in Beltsville, Md.

Raymond Kurzweil plays an original piece of music composed by a computer which he designed. The computer has turned out dozens of classical and romantic compositions.

INVENTOR OF THE MONTH

He gave cotton a reprieve

NELSON F. Getchell (above) of Washington has handed the cotton industry a weapon to use in its war against the synthetic fiber makers for the important trouser market. A research specialist for the National Cotton Council, he has invented a special cuff.

Tailors usually make cuffs by turning up the trouser bottoms and ironing them. But the cotton industry, in devising wrinkle-resistant clothing with creases that would not come out in the wash, did such a good job that the tailors could not reverse the creases.

Getchell devised pre-formed cuffs to be attached to the ends of the trouser legs. The tailor cuts off the legs at the proper length and sews the cuffs in place. Patent 3,166,765, which *Science Digest's* Inventor of the Month recently obtained for the Cotton Council, covers the cuffs' construction and their treatment with plastic so they won't fray. Council members will be licensed under it.

Man-made fibers can be reset by heat, but after cotton trousers go through the modern "delayed cure," they cannot. The cloth is treated with a chemical and, once the garment is made and pressed, heat is applied.

There is no problem with men's and boys' wash slacks, which can be made in many lengths and waist measures and sold with finished cuffs. But the suit and dress trousers are carried in stock uncuffed.

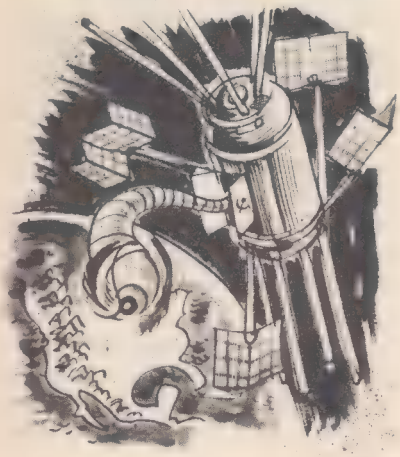
The No. 1 consumer of cotton is the men's and boys' pants market. Cotton furnishes nearly three-quarters of the material for separate trousers and dress shorts, and the industry wants at least to hold its position. It would also like to get more of the smaller but valuable suit market. Here cotton supplies less than an eighth.

Nelson Getchell was made a bachelor of science in textile chemistry by Lowell Technological Institute in 1938, and has been with the council since 1951. Last year he patented one of the "delayed cure durable press" processes used in the industry. Earlier he was co-inventor of a method of trouser recuring to put in permanent creases.

—*Stacy V. Jones*

THE MILITARY STORY

'War' in space



by Hubert Pryor

IF YOU'VE been looking at the stars recently and have had the eerie feeling that someone's been looking back at you, you're right.

Aviation Week reports that the Soviet Union has kept the United States under regular surveillance by photo reconnaissance satellites for the past year.

Of 36 satellites put into orbit by the Soviet Union last year, the magazine says, 14 were camera payloads "under cover of its Cosmos satellite program."

The use of some Cosmos satellites for reconnaissance has been suggested by U.S. officials, who've been aware for some time of such a Soviet capability.

Within 24 hours of the magazine report, incidentally, the Soviet Union launched four unmanned satellites—the last one, the Cosmos 57.

Publicly announced shots in the Cosmos series sometimes are described in some detail, with data as to orbits and indications that the purpose was to provide, say, weather information. But more often than not, no information is released.

A listing in *Information Please Almanac* of shots through last October 14 numbers 36 Soviet satellite launchings about which no, or almost no, information was released.

Of course, the United States has also been keeping an eye on Russia from space, and presumably on Red China, too. The same chronology of satellite launchings through October 14 lists 56 U.S. secret shots.

As reported in *Science Digest* in March, 1963, two of our military satellite series have been the Samos (satellite and missile observation system) and the Midas (missile defense alarm system).

The same report also mentioned three *counter*-satellite programs undertaken or contemplated by the U.S.: the Army's Nike-Zeus, the Navy's Early Spring and an Air Force program known as Project Saint. The latter was described as a "satellite inspector," which could locate and inspect a probable hostile spacecraft as it orbited.

Orbiting bombs? The United States, at least, is on record as having no intention of developing any. In any case, missiles are thought to be as effective and less vulnerable.

The vulnerability of satellites is being taken into account by the Defense Department, however, in plans for military space craft for communications. *The Wall Street Journal* reports that the Pentagon is planning to launch 24 communications satellites in random orbits early next year. Eight satellites would be sent up at once aboard three Titan IIIC booster rockets. They would be shot out at differing speeds and gradually spread out to give near-global coverage.

The satellites would circle the earth at about 21,000 miles altitude and would be followed two years later by another series at other altitudes.

The theory is that the great number of satellites and the variety of their positions would provide a communications network almost invulnerable to destruction.

Why doesn't the military use ordinary radio? The fact is that, more than many people realize, atmospheric conditions often blank out world communications almost completely. In an emergency in Vietnam last November, the only way the Pentagon could communicate with commanders on the front lines was via the Syncom satellite.

The concept of war in space is still in the realm of Buck Rogers fantasy, but only when you think of it as a contest between planets. If you think of space as having the same strategic importance as the high seas, a region of *access* between combatants, obviously space must command the attention of all military strategic planners.

Consider, for instance, an Associated Press report from Honolulu on February 13. The Danish freighter *Margit* caught fire in the Pacific and a Navy cargo ship picked the survivors up from lifeboats 1,100 miles south-southwest of Honolulu and headed for nearby Johnston Island.

"If the group is allowed ashore," the report said, "they'll be among the first non-accredited people to have set foot there in recent years."

No lack of charity lay behind the cool reception. Medical attention was assured the injured, if aboard ship and not ashore. The reason?

The island, said the AP, is constantly being built up in connection with the United States anti-missile program, and was the scene of America's atmospheric nuclear testing before the Moscow A-ban treaty.

War in space? Maybe not. But the world's two top military powers today are actively engaged in *defense* in space—and they're likely to be even more so in the future.

What will the moon feel like?

Wide World

Rocket to be used in putting Surveyor on the moon blows up, but program will go on.

by Daniel Cohen

We now have a pretty good idea of what the surface of the moon looks like—close up. But we are still a long way from knowing what it will feel like, when and if the astronauts from our Apollo program land there.

The photos from Ranger VIII look almost exactly like those taken by Ranger VII of a different area of the moon. This indicates that the moon's surface is probably pretty much the same all over.

But what happens after a craft lands? Will the surface be strong enough to support the 26,500-pound lunar excursion module, or will it go crashing through fragile and frothy rock, which some scientists believe the moon's surface is made of?

Another frequently mentioned hazard is dust. Many scientists think the moon is covered by a thick layer of dust, which might be as much as a half-mile deep. The Ranger photos have neither proved nor disproved this theory. If the dust layer is anywhere near a half-mile thick, the LEM would simply sink out of sight and the expedition would be a disaster. Even a much thinner layer might cause the LEM to topple over on landing.

An attempt to answer these questions received a serious setback on March 2 when an Atlas-Centaur rocket carrying a dummy Surveyor spacecraft exploded on its launching pad. The Surveyor is scheduled to make a "soft" landing on the moon and radio back information about the surface.

The March 2 shot was to be a prelude to a live Surveyor shot scheduled for the period between Sept. 26 and Oct. 2.

The explosion, it was thought, would delay the live Surveyor shot and the Apollo program itself, but this was later denied.

There is also the possibility, although no one likes to talk about it, that once Surveyor gets to the moon, it will send back information that will completely wash out the entire Apollo program.

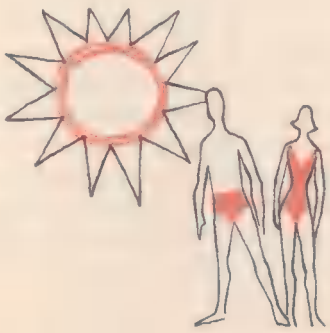
5 myths about health

by Arthur J. Snider

IN SPITE of the scientific sophistication that characterizes their culture, Americans still entertain unscientific concepts of health and illness, says Dr. Charles E. Goshen of Morgantown, W. Va.

He lists some examples of irrational concepts of health in *The New Physician:*

"The healthy suntan"—Even highly educated Americans are likely to subscribe to the notion that a sun-darkened epidermis represents some kind of guarantee of good health. This notion goes back to the old observations that sick people are likely to be pallid in appearance while healthy people are more likely to show the effect of exposure to the sun. The answer, of course, was that the sick remained indoors and the healthy lived much more of their life out-of-doors, where most people worked. Today, the opposite is more likely to be true. Most of the work in our modern society now takes place indoors, while the people most likely to have time to sunbathe would be the sick ones. It is naive to assume that changing the color of the skin would change the state of health.



"Exposure to cold, wet weather brings about upper respiratory disease"—In spite of the fact that the germ theory of infection is widely understood and accepted this ancient idea is still widespread. The first sign of a virus infection, such as the common cold, is often a chill followed by fever. Our ancestors, unaware of incubation periods of infection, were inclined to assume that "chill causes fever." From this logic it was deduced that if one could avoid being "chilled" then one could prevent the fever. The truth is that the common cold and most upper respiratory diseases are contagious illnesses, caused by viruses and bacteria transmitted from one person to another. Thus, the correct health warning, Dr. Goshen says, is, "If you want to avoid catching colds, keep your distance

from other people that have them."

"Sick from overwork"—A person who puts in substantially more time in his work than does the average man is likely to make more money, have more marital difficulties, have less pleasure in life and be exposed to a greater risk of industrial accidents. Otherwise, he will not show a health history different from the more average person. He might be more dissatisfied with his all-work-no-play life and as a result complain a great deal more than others. The frequency of complaints, however, is never a reliable index of the state of health. The "overwork" concept arises from the human tendency to blame our own dissatisfactions in life on circumstances.

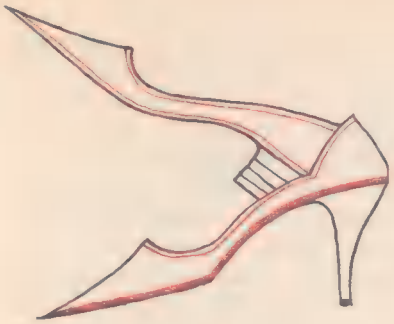
"Taking care of one's health"—Most people assume this means going to bed early, sleeping long hours, eating meals at regular times, avoiding smoking or drinking. But the background of this belief is largely a moralistic one, says Dr. Goshen. In the past, it was often noted that the people who lived wasteful, unconventional lives not only tended to follow very irregular habits of sleeping, eating and working but also appeared dissipated. But the dissipation was often due to the effects of malnutrition, chronic alcoholism and venereal disease. These were related to unconventional modes of life. It seemed reasonable to conclude that a conventional "virtuous" life was healthier Actually, there is very little known scientifically about what a person might actually do to protect his health effectively. The two most common killers in American society are cancer and arteriosclerotic cardiovascular disease, neither of which is preventable.

"Exercise is healthy"—Even the President of the United States has endorsed this concept, yet Dr. Goshen believes it is not any less inaccurate. This notion stems from the fact that healthy people are more frequently seen working and exercising than sick ones. But it is not the exercise that makes the one healthy and not the lack of it that makes the other sick. People who have lived very long lives essentially free of serious illness do not show any particular preponderance of athletes or devotees of physical fitness. Enjoyable exercise, such as playing golf, is a great uplifter of morale and spirits, but has not yet been shown to have any direct bearing on the state of health.

The female foot

If there is very little drinking from ladies' slippers these days, it's probably because they're just too big to drink from, Dr. Paul J. Davis of Harvard Medical School has concluded.

"Once scarcely large enough to contain an aperitif, the shoe of the female has become a veritable tankard, holding 14 ounces or more, by actual test," he comments. He attributes the blossoming of the lady's foot from the fragile and finely-drawn bud of the 1920's to three factors:



(1) The average female is about 14 pounds heavier than her counterpart of four decades ago.

(2) The average female today has been reared in ignorance of foot discipline. From the age of six months, she is placed in high-topped, quasi-orthopedic shoes which prevent normal arch and ligamentous stresses. Then a sudden reversal of attitude occurs at age five years when girls begin their exposure to a continuum of sandals, flats, clogs, loafers and moccasins, which permit ligamentous laxity to slide into orthopedic catastrophe.

(3) The average female has changed her pedal values. She has grown callous to the centuries' old reverence for modest and unpretentious proportions of the foot. A social emphasis upon generous proportions misleads the generation to regard its big feet with, if not veneration, complacency

"As if permissive footwear weren't enough, the helpless female foot is occasionally driven into a pointed toe-spiked heel device which is medieval in design," says Dr. Davis. "It is worth noting that in the thirteenth century, shoes' pointed toes reached a length which required chains for support that were attached to the knees. Perhaps this exuberance will not be eclipsed but I would not bet on it. Even today there is only casual relationship between the length and shape of the shoe and the length and configuration of the foot it encumbers."

Women's shoes that used to fit comfortably into suitcases are now large enough to justify valises of their own, Dr. Davis observed.

The panty girdle syndrome

The patient, a 20-year-old secretary, had been complaining of swelling of her feet and ankles for two years. Several laboratory tests had been carried out to uncover the cause and she was found perfectly normal. Questioning by Dr. Charles A. Ribaudo of New York revealed the swelling was not present in the morning but became progressively worse during the day. During the summer, spent on the beaches, there was no swelling.

When a physical examination revealed a circular indentation of the skin of both upper thighs, Dr. Ribaudo traced the cause to a panty girdle with its tight, elastic bands that created a tourniquet-like effect. On discontinuing the garment, the patient was free of swelling within days.

Dr. Ribaudo reported the first case of "panty girdle syndrome" in the New York State Journal of Medicine.

How to turn green

The two ladies were green, but not with envy. They were members of a small, secretive French religious society whose members not only were strict vegetarians but also ate clay in the religious belief that since man sprang from the soil he must return to it for sustenance. Their green color was caused by an overabundance of copper in the clay.

Dr. Charles Grubber, chief of the dermatology clinic at the Hospital of St. Louis, Paris, France, told the story before a meeting of skin specialists.

"The first patient, referred to me because of discoloration of the skin, was a very intelligent woman, a teacher of mathematics. She was in her 40's but appeared to be much younger. Her complexion, except for its color, was the finest I have ever seen. Her skin was green everywhere, even inside her mouth. The corneas of her eyes were green glazed."

The second woman, a notary clerk, was in her middle 50's but seemed unbelievably younger. Like the first woman, she said she was a vegetalian rather than vegetarian. A vegetarian will eat fruits and vegetables, milk and eggs. A vegetalian will eat only fruits and vegetables.

Both women said they ate many grapes and seldom washed their food before eating on the grounds that food should be as natural as possible Clay is eaten as a supplement.

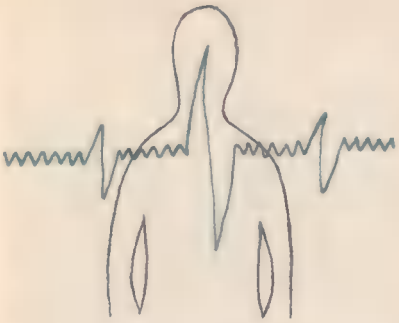
"I told them that I could restore their natural color with a drug," said Dr. Grubber, "but I did not know if they would also lose their youthful appearance along with their green complexion. Both of them considered my offer and refused. They decided that they would rather be green and young. Both seem to be happy. They now live in Paris. The teacher is rather self-conscious and teaches at a correspondence school. But the notary must meet strange people every day. She thinks nothing of it."

Why healthy hearts look sick

It has been 50 years since the invention of the electrocardiograph (EKG), the electronic measurement of the heart function. But many doctors are still misreading EKG's and turning patients into cardiac cripples by hasty pronouncements.

Dr. Herbert Steinberg of Philadelphia says there are many factors that can cause erratic patterns in patients completely free of cardiac problems. An individual's physical makeup, sitting upright, pregnancy and obesity, can cause erratic waves in healthy individuals. Other noncardiac factors that stimulate irregular patterns are emotional and physical stress, smoking, metabolic disturbances, allergies, digestion, infectious disease and physical exercise.

"Even the prospect of taking an EKG before surgery creates patient fears and anxieties which cause erratic patterns," Dr. Steinberg says.



Recent abdominal surgery, even administration of medication can send waves on erratic bounces. Of course, once a worried patient learns the initial EKG isn't 'normal', the anxiety can be so disruptive that it may be months before fluctuations stop. Studies show that fasting, standing, rapid or deep breathing, even glucose injections, are effective in "normalizing" such patterns.

Anatomy of an epidemic

If man can conquer microbes in the hospital—a seed bed of potential disaster—he can certainly prevent epidemics in the environment, a germ authority says. In many ways, the hospital environment represents all the hazards that would start an epidemic elsewhere.

"Here is concentrated under one roof a group of highly susceptible patients into which periodically there are introduced individuals with diseases caused by the most dangerous disease-producing organisms."

Yet, with the application of relatively simple techniques, the hospital provides a safe environment for the care of human ills.

Dr. James G. Shaffer, chief epidemiologist of Lutheran General Hospital, Park Ridge, Ill., suggests that those concerned with community health problems can learn much by studying the hospital environment.

It is a mistaken conception that knocking out a disease means elimination of the germs that caused it.

Many of the germs are still present and are even being transmitted from person to person. But they are prevented from assuming epidemic status by a combination of environmental control, vaccination and appropriate treatment.

Normally, we are surrounded by disease-producing agents. They live on the surface of the skin, in the mouth, the throat and the lower portion of the digestive tract.

In other words, man and microbes live in armed truce. "Thus the great unknowns in man's relation to microbial disease are the complex determinants that allow disease to develop from infection."

Nevertheless, it is believed the individual rather than the microbe is the determining factor in whether disease occurs.

"Ironically," he added, "the success that has attended the application of public health and medical measures to keep people alive results in the development of an increasing number whose susceptibility to microbial disease is enhanced."

How can I find out?

RESEARCHERS, please note: The Library of Congress and a New York publisher, Plenum Press, have come to your aid.

Each has published a work that should help take much of the pain out of finding the scientific and technical data you need.

The Library of Congress's National Referral Center for Science and Technology has prepared *A Directory of Information Resources in the United States,* covering the physical sciences, biological sciences and engineering.

The directory lists a wide variety of organizations and institutions capable of meeting specific information needs. Included are libraries, information centers, professional societies, universities and industrial firms, as well as government agencies or offices that provide assistance in particular fields. Some 1,100 individual resources are listed, with a description of specialized interests, services and publications. There is also a subject index.

To order the directory, send $2.25 to: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. The catalog number of the directory is LC 1.31:D 62.

A directory covering the social sciences is due to appear next.

The National Referral Center, incidentally, was set up in 1963 as an "information desk" for the scientific and technical community. With the support of the National Science Foundation, it functions as an intermediary, directing those who need information to those who can provide it.

Besides preparing directories like the one recently published, it is compiling a comprehensive inventory of all the significant information resources it can identify. It is soliciting contributions by organizations that represent such resources in the physical, biological, engineering or social sciences.

If you want help in locating information, you can write the Center in care of the Library of Congress, Washington, D.C. 20540. Or you can phone (area code 202): 967-8087 for general inquiries, 967-8265 for referral service and 967-8242 for registration of information resources.

The work published by Plenum Press is the initial product of an unusual compilation by its new Data Division, said to be the first of its kind set up by a major publisher. In two volumes, the work is titled *Electronic Properties of Materials*. It is derived from 13,500 published references on this complex subject.

What distinguishes it is that it

H. Thayne Johnson displays two-volume work he edited with 13,500 published electronic references processed by computer.

disseminates data previously available only at computer centers.

The 13,500 so-called "accessions" were originally programmed by the Electronic Properties Information Center, administered by Hughes Aircraft under contract to the U.S. Air Force. The two volumes present the results of over three years' work of a team of from six to eight scientists.

In the words of H. Thayne Johnson of EPIC, who edited the work:

"This team scanned the international literature for publications on the electronic properties of materials and considered over 150,000 of these for referencing in the guide."

As part of the project, an IBM 1401 computer was programmed to take the complex input from the 13,500 publications selected and prepare it for listing in two volumes.

"This indexing system that was originally chosen for EPIC, which is reflected in the guide, might be called a modified coordinated index," Johnson says. "Two files are represented. One is a master print-out from the computer. The second consists of bibliographic entries. which appear in the second volume.

Descriptors

"The print-out is the descriptor file, consisting of alphabetically-arranged descriptors. This file is divided first into descriptors of materials, and second into descriptors of properties. Under each are listed the accession numbers of the appropriate articles."

The price of the work is $150. For information concerning it, contact Plenum Press, 227 West 17th Street, New York, N.Y. 10011.

A total of 10 books are planned by the Data Division of Plenum Press in 1965.

"We are convinced," says Plenum President Earl M. Coleman. "that the application of computers to information retrieval is keenly important at this stage of computer technology. Our new division will make widely available to the scientific community, data originally slated for only restricted distribution. The Data Division will forestall tremendously wasteful duplication of research in hundreds of laboratories."

PERSONALITY OF THE MONTH

His science is mixing

Courtesy Purdue University

by Lawrence Galton

COMMONPLACE as it is, mixing is a complex affair. Every housewife mixes up something almost daily—but not necessarily properly. Every do-it-yourself home painter mixes—but not necessarily efficiently. Mixing is an essential part of virtually all chemical, and many other, processes. A great deal of research has gone, and is still going, into it.

One of the outstanding investigators in the field is Prof. J. Henry Rushton, (above) of the Purdue School of Chemical Engineering.

As a result of his continuing contributions and those of many others in the field, mixing today is becoming more scientific, and this accounts for many economies in the production of items for everyday use. Some products—for example, modern automotive lubricating oils about 40 percent of whose composition consists of special polymerized compounds—have been made possible only by efficient mixing processes.

Put an impeller—any rotation body such as marine or airplane-type propeller, or simple paddle—in a liquid and it will produce rotary but no mixing motion. Actually, a vortex will develop; the fluid will swirl round and round; the particles will tend not to mix any more than do the animal figures on a merry-go-round.

With baffles added, however, the rotary motion is interrupted; things start moving up and down as well as sideways; vortexing dies off; mixing begins.

In a big tank, where a marine-type propeller may be used, the positioning of the propeller can be critical. In general, the less vortexing, the faster the mixing and the chemical reaction rate. If the propeller goes in from the side—as it must in a big tank—it should rotate clockwise and be positioned to set up a clockwise motion of the fluid. This, it has been found, minimizes vortexing. In fact, if the propeller is angled properly, it can be made to produce powerful enough forces to neutralize and prevent swirling, thus eliminating the need for baffles and their cost.

Choice of the right kind of propeller is also critical. Too small a unit operating at high speed may succeed only in boring a hole in the fluid. To pick the unit best suited to put a whole tank load into mixing motion requires a knowledge of the flow-inducing characteristics of various propellers, how they behave under different conditions of speed and with different fluids they may be called upon to move, and how much power (and, therefore, cost) it takes to operate them. One of the important contributions of Rushton and his co-workers has been the patient quantization of a broad range of mixing problems, and the development of criteria for the choice of the most efficient equipment and procedure in each case.

Mixing problems turn up in a wide variety of situations—even, for example, in moving materials through a pipeline.

Recently, Rushton has also worked on a problem involving this. Into every home fuel tank, a little bit of the oil refinery flows. Always, there's a small amount of iron oxide in fuel oil because inevitably a refining plant rusts slowly away, and some rust is picked up and suspended in the oil.

As oil moves through a pipe, it may pick up other solid materials. The problem is to make certain that, when the oil arrives in the home heater, it is free of any sludge that may plug the burner.

Essentially, it's a problem of accurate sampling as oil is piped in, through, and out of a refinery. Such sampling has been difficult since concentrations of small solid particles—and also of small particles of liquid such as water—can shift over the stream at different flow velocities.

Rushton now has developed a relatively simple sampling technique, using a tube. The critical factor in picking up a representative sample, he has established, is to

Household tips for good mixing

Suggests Professor Rushton:

In mixing a cake batter, tip the bowl while rotating the batter. That way, you get vertical currents of flow and avoid the merry-go-round effect; *the mixing will be done faster and with less effort.*

The same rule applies to mixing paint: tilt the can.

To mix coffee, cream and sugar, don't stir round and round in the cup. Merry-go-round effect again! To get a quick mix, move the spoon back and forth across the cup. The same back and forth motion is equally effective when using a paddle to mix paint.

When it comes to air mixing—for room ventilation or cooling, for example—best bet is a large impeller operating at slow speed. A big, slow-turning fan will provide maximum comfort because it induces more flow, less turbulence, moves air farther as well.

have velocity of flow within the tube exactly the same as the velocity of flow, whatever it may be, for the whole stream. He has developed tube design and placement criteria which now permit taking a sample so representative that it reveals what's in the whole stream.

Two events occur when an impeller is used: Fluid is moved, and turbulence is generated. For the same amount of power applied, Rushton's studies have shown, there can be more or less turbulence depending upon size and speed of the impeller. With a large, slow-moving impeller, a large amount of material can be moved with minimum turbulence.

Until three or four years ago, it was thought that a pilot plant study in a small tank, one no bigger than six inches in diameter, was enough to establish the effects on mixing of the physical properties of all components in a new chemical process and the type of impeller needed for best results.

It has become clear, however, that the size of the operation itself is an important factor in the rate at which chemical reactions take place. Rushton's investigations have led to a rule that calls for pilot plant studies to be done with three different sizes of equipment, not necessarily large, to provide an indication of the influence of size and allow better design for the full-scale operation.

"Mixing," observes Henry Rushton, who has devoted his career to its study, "has come a long way in recent years—but still has a long way to go. There's nothing simple about it."

New pay phones are 'pilfer-proof'

A BRAND new pay telephone—described by its designer as the first real design change in coin telephones in 35 years—will be made almost entirely of aluminum to meet rugged operating conditions.

Objective of the new design was not only to incorporate the latest advances in telephony, but also to solve the telephone industry's huge pilfering vandalism problem, since attacks on coin telephones are causing losses of millions of dollars every year. Improved coin-evaluating mechanisms, locking devices, and circuitry took care of the more sophisticated means of cheating; what remained were the brute force methods, such as attack with torchs and cutting instruments, removal from the wall, and similar practices aimed at getting to the money inside the telephone.

Pocket cutting torches—favorite implement of one class of telephone thieves—will be ineffectual against the new phone. Streamlined, seamless construction coupled with flush-to-the wall mounting, deny vandals any gripping surface or prying space.

All exposed surfaces are highly scratch-resistant and tarnish- and erosion-proof. Pencil, ink and lipstick markings can be removed quickly and completely with mild soap and water.

Do-it-yourself hallucinations

Do you want to start seeing things?

If you do, all you need is an hour's peace and quiet in your own dimly-lit bedroom, earplugs and a pair of goggles with white paper pasted over the front. If you can lie completely still and keep from falling asleep for about 60 minutes, you will probably begin having hallucinations.

Two Michigan State University psychologists, Robert F. Morgan and Paul Bakan, found this simple technique could produce hallucinations in two out of three student volunteers. In "sensory deprivation" experiments, where subjects were cut off from outside stimuli, in varying degrees, hallucinations were often experienced. The Michigan psychologists wanted to find out how and why.

A hallucination is defined as an image seen out in front of the eyes that is not under the subject's control and can be scanned from side to side.

Thirty-six subjects, ranging in age from 16 to 34, participated in the experiment. All were volunteer college students from an introductory psychology course. There were 16 males and 20 females.

Half the subjects spent their hour lying on a couch, the other

The theory held by psychologist Morgan is that hallucinations seen under conditions of sensory deprivation are really waking dream fragments.

half sitting in comfortable reclining chairs. In each group, some of the subjects were instructed to remain completely quiet, others could report on how they felt from time to time during the hour, still others were required to talk continuously during the period of the experiment. None of the subjects were allowed to move their bodies or shut their eyes (although some did fall asleep). Before the experiment started, all 36 had been tested as to their intelligence and anxiety level, and questioned on the amount of day dreaming they normally did.

Horizontal hallucinations

The most significant variable was the position. Four times as many members of the group that was lying down had vivid hallucinations as did members of the sitting-up group.

None of the other variables (sex, intelligence, amount of normal daydreaming, etc.) had any significant effect on the tendency to hallucinate, although those who did hallucinate tended to be somewhat younger than those who did not.

What were the volunteers seeing while they were lying there? Vividly and in color (most hallucinations are in full color) they saw things like: A fight scene from *West Side Story*, a father's accusing pink and green face with mother in yellow and a purple background (all of which disappeared when the subject's eyes opened), a girl in a red bathing suit, Mother against a lake of colored blobs (mostly purple), red roses in front of a library and brown blobs going through black rocks looking for a hole.

Airplanes, horses, spiders

Less vividly and sometimes in black and white, other subjects saw things like airplanes, horses, spiders and lightning. Still other subjects experienced feelings like floating through space or being hit in the eye with a wet towel.

Why do hallucinations appear?

Says psychologist Morgan, "Our experiment showed that it didn't seem to matter whether the subject talked or not or whether he was anxious or not. There were no differences according to sex or intelligence. Our theory is that hallucinations seen under conditions of the sensory deprivation situation are really waking dream fragments.

"The closer the sensory deprivation situation to the conditions under which you sleep at night, the more likely the hallucinations will come. This is why we contend that in our experiment the recliners hallucinated more frequently.

"The other necessary elements

also tie in: When sleeping, we are relatively immobile, no one speaks to us (although we may do some talking on our own), and usually enough light is around (moon, streetlights) to make our eyelids a dimly lit screen against which our dreams are projected. Putting a subject in translucent goggles, laying him immobile on a couch for an hour duplicates the essential sleep situation's elements, so that behavior that has been 'conditioned' to these elements, like dreams, starts running itself off."

An incidental observation the psychologists reported in their paper on the experiment was that those subjects who had to talk continuously often drifted into conversational free association, "which often exploded spontaneously into a one-way therapy session. While beyond the scope of this discussion, the combination of horizontal sensory deprivation and forced free association is a dynamic one, well worth the attention of personality theorists and psychotherapists."

Psychologist Morgan says of his do-it-yourself method of producing hallucinations, "I recommend it highly for the man or woman who's interested in analyzing his own dreams at the best possible time: as they occur.

"As for what a person is to make of what he sees, I advise a reading of Freud's section on dreams and their meaning in his *General Introduction to Psychoanalysis*."

TIPS AND TRENDS

THE PROSPECT FOR CLEANER AIR AND WATER. A Business Week report says companies now spending an estimated $400 million a year on water pollution control will soon be forced to double or triple that outlay. In view: a new Water Pollution Control Administration. In Chicago, the U.S. began action under the present, slow-moving process against industries polluting southern Lake Michigan. But four Chicago steel producers agreed to spend $50-100 million to help control air pollution. Next summer, a government report is due on a study of the water of the Upper Mississippi basin. In bad shape: Long Island's underground water. Its level is down; its pollution, up. New York City announced plans for a series of air monitoring stations, but state officials implied the need for strong action.

PROFITS FROM THE SEA. There's wealth in the world's oceans. To help tap it, seven universities of the South proposed the Gulf Coast Marine Sciences Center. And Westinghouse said it would build an oceanographic laboratory near Annapolis, Md. By mid-year, the company will be in possession of the Deepstar-4000, able to go down 4,000 feet.

NEW WAY TO GENERATE ELECTRICITY. Fuel cells loom more and more important in our future. Newest way to make-your-own-electricity is an Esso cell that burns wood alcohol and uses the oxygen in air. It weighs 29 lbs. and produces 100 watts at 5 volts.

AEROSPACE HAS A BRIGHT FUTURE. So declares Lockheed Vice-President Dudley E. Browne. The decline in defense spending has been misunderstood, he says. He figures 1969 is "at the bottom of the dip." After that, obsolescence will bring a new rise.

WILL SCIENCE DO WHAT POLITICS CAN'T? Political writer Walter Lippmann thinks it will. He told a UN meeting that the revolution in man's ability to control nature has enabled him to substitute plenty for poverty. The new, emerging societies, he said, will find a prosperity in technology that is "better than any that can be attained by a struggle of classes." Thus neither capitalism nor communism will win the cold war.

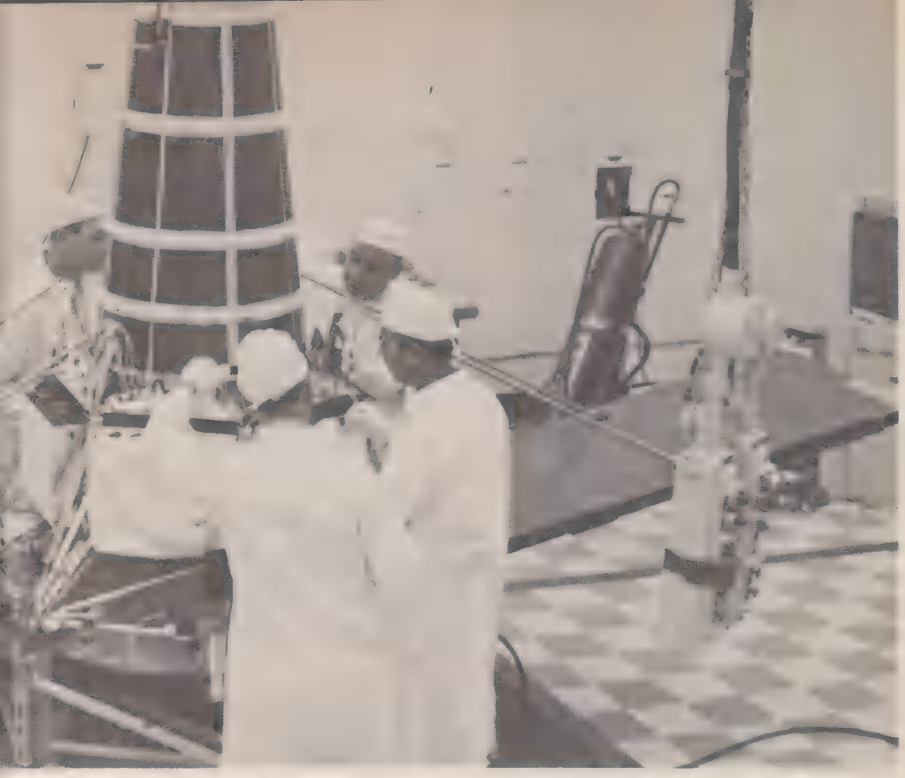
WHERE DO RELIGION AND PHILOSOPHY FIT IN? Theologians and intellectuals in nearly all fields of culture are actively seeking an answer. A New York meeting of over 250 scholars and religious leaders heard speakers plead against hostility to the machine. An economist urged religious groups to come to terms with the changing world, to prevent man's becoming a "dehumanized robot" in the inevitable automation that's ahead. Another meeting sponsored by the Foundation for Integrative Education bemoaned "overspecialization unrelieved by philosophical reflection." Result: "a conceptual breakdown in modern society that has led to its ethical and social distresses." An up-beat note was sounded by Yale's Prof. Henry Margenau. Modern science, he said, is now humble; religion, less dogmatic.

THE SPACE PICTURE

Moon shot—from start . . .

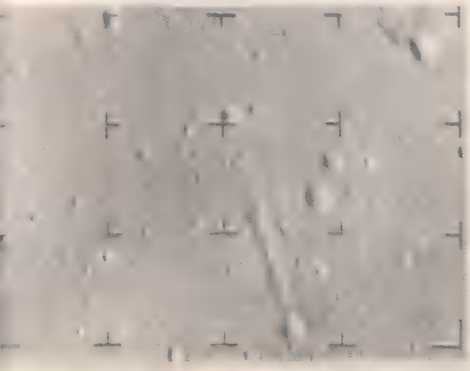
The Ranger series of moon probes are incredibly complex mechanisms. The recent success of Ranger VIII was the result of months of painstaking checking. Above: technicians check Ranger before launching.

Left: Liftoff at Cape Kennedy for the rocket carrying Ranger VIII on its mission to the moon. Ranger sent back thousands of excellent pictures but many questions about the moon's surface remained.



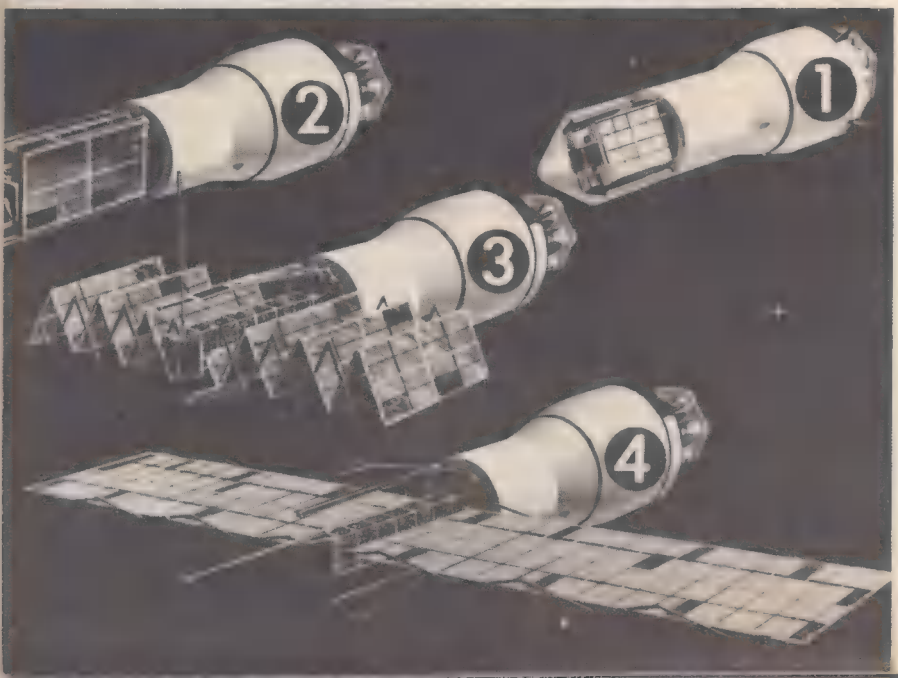
. . . to finish

Television pictures below were taken by Ranger VIII prior to impact. Left: The southwest corner of the Sea of Tranquillity and large flat bottomed craters Sabine and Ritter are shown. Center: Shot taken 45.6 seconds before impact of two elongate and one irregular depression. Spacecraft altitude above moon was 50 miles. Right: Last frame taken at 0.4 seconds before impact, covering an area of 300 by 400 feet. The smallest crater shown is about five feet in diameter. The spacecraft altitude above the moon was 2,400 feet. North is at the top when shadow is left of the craters.



Horse in space

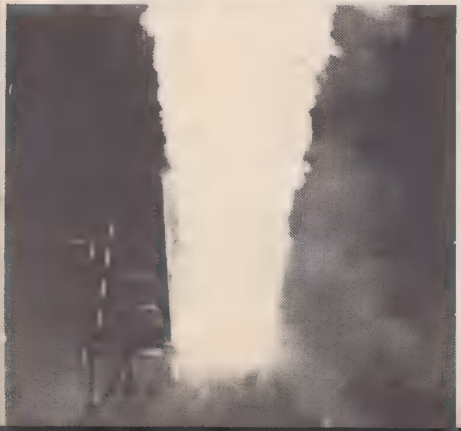
Below: Two of America's space experts, Dr. Wernher von Braun and Dr. Kurt M. Debus, confer on the mission of the giant Pegasus meteoroid detection satellite shortly before launching atop a Saturn I rocket.



Right: The Gemini spacecraft being lifted to the top of a Saturn rocket at Complex 19, Cape Kennedy. The rocket and craft were being prepared for the two-man space-flight of Astronauts Grissom and Young.

Left: Diagram of the Pegasus satellite's meteoriod detection panels being unfolded in space. When fully extended the panels have a span of 96 feet. As meteorids strike them the force of the impact is recorded.

The world's largest rocket motor, generating 3.2 million pounds of thrust, sends flames and smoke towering 2,000 feet during a static firing test. The motor burned 800,000 pounds of fuel in the 64 sec. test.



How fast can you react?

by R. S. Tripp

Most people don't know what reaction time really is or what affects it. It is abbreviated RT and is more correctly called "human time lag." For our purposes RT will be defined as the time elapsing between the beginning of a signal (stimulus) and the completion of the response.

RT can be broken down into segments; time required to sense the signal (sensing time), plus time required to decide what response to make (decision time), plus that required to respond (movement time). Within these groups are two neurological lags during which the sensory impulse travels toward the brain and the movement impulse travels from the brain.

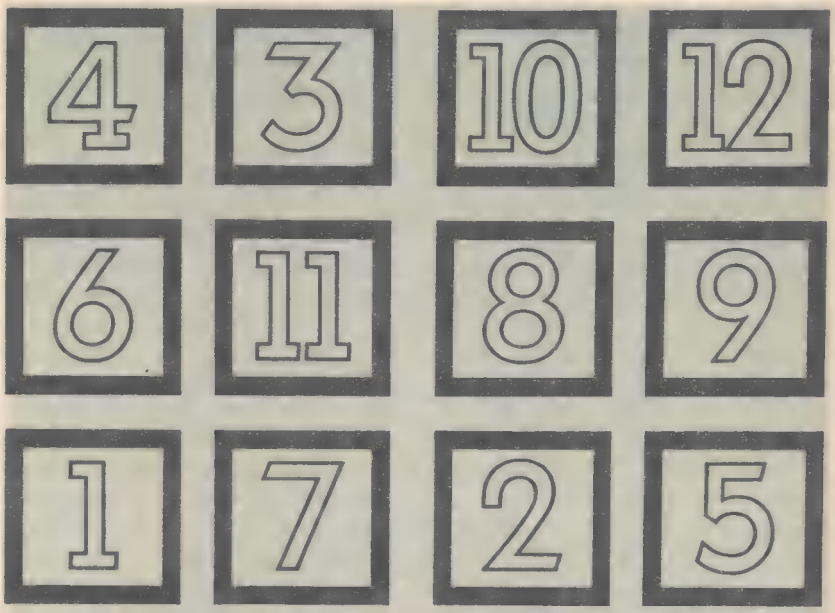
As an example, a flight leader is out on a patrol mission. As he herds his group around a bank of clouds they are suddenly "attacked" head on by another flight coming from the opposite direction. It typically would take him 0.9 second to see, focus and interpret what he sees as aircraft, another 0.5 second to make his decision, and 0.3 second to actually respond by moving the controls.

Each sense has its own reaction time, though the difference between most of them is small. The pilot was not forewarned and did not know the direction of the oncoming planes. The size and brightness of the aircraft would affect his ability to perceive them and make his decision. How to avoid the oncoming ships is a complex decision—dive, pull up, or turn—and might be further modified by the type of aircraft he was flying, and whether he wanted to attack or escape.

Practice can greatly reduce decision and movement time by eliminating incorrect decisions and making the correct movements more efficiently. Simplifying the task and eliminating the decision portion (pushing a button in response to a single light) can reduce the time to 0.2 second and slightly below. Simple involuntary reflexes take 0.06-0.1 second.

In spite of all the research that has gone into RT, it is still impossible to state what any one person's RT will be at any particular time even to a single test. RT will vary within a person from day to day and even from moment to moment. Any generalization about someone having fast or slow reactions is misleading if the conditions aren't specified.

RT can be affected by nearly any factors, some of which are obvious. Early experiments quite often ranked each sense with a specific RT: sound .140, vision .180, touch .240, etc. Later it was pointed out that no attention had been paid to the logic of measurement between senses. The only scale used had been opinion, which was extremely unreliable. (Who is to say that a



See how long it takes you to touch each square in numerical order.

9 seconds? Your reflexes are about average.
7 seconds? Very good.
5 seconds? Excellent.

More than nine seconds?
Your reactions are too slow.

certain light is as bright as a sound is loud or as a smell is strong?) Recently, more sophisticated devices have allowed comparison between the senses. The RT's to light, sound, and touch are now generally considered to be the fastest, with negligible differences between them.

In spite of these difficulties, certain factors have been studied, isolated, and considered generally acceptable. Below are a few common beliefs about reaction time and what scientific studies have revealed about them.

A warning given to you ahead of time shortens your reaction time. Logical and generally true. In human factors work, this is known as the foreperiod and is most effective

Learn as much about a situation as you can. Anticipate, try to eliminate the unknown and reduce the decision time by finding solutions beforehand.

if the warning is given one to eight seconds before the response signal.

As you grow older you grow slower. False. You don't slow down noticeably with age until approaching the age of sixty. Experience will usually balance off any slowing up to and beyond this point.

Men are faster than women. True. Men have an edge over women in most tests particularly the more complex ones.

Rewarding a person will cut down his RT. True, with negative rewards (punishment) for reacting slowly seeming to be more effective. Thus it can be seen that bullfighters, racing drivers, and pilots, who face both positive rewards and the most severe negative reward (death) have both factors working for them.

To be a jet pilot or an astronaut your reactions have to be exceptionally fast. False. Present day jet pilots and astronauts are not even tested for simple RT. If a man has some neurological disturbance that badly upsets his RT capability it will show up in other tests. The individual RT variability existing between pilots is overshadowed by each pilot's capability to learn, exercise good judgement, perform under pressure and adapt to unusual conditions.

There is a definite link between a person's intelligence and his RT. False. Intelligence as measured by IQ tests of the Stanford-Binet or Weschler-Bellevue type produces results only at the extremes of the scale, particularly in complex tasks. Even this effect is still open to discussion.

Lack of sleep slows down your RT. Sleep deprivation produces no change in RT until the subject is near the point of collapse. Then the most usual result is no response at all as the subject temporarily lapses into unconsciousness.

Drinking coffee or taking benzedrine will cut down RT. These two seem to have a neutral or negative effect on wide awake subjects. When used after a sleep loss they can cut down RT.

Smoking slows down your RT. False. Cigarette smoking produces no measurable result.

Liquor, in any measurable amounts, slows down your RT. The question of liquor's effect on human performance in general and RT in particular has been the subject of controversy. A small amount of liquor will actually improve the RT of some people who are normally too emotionally inhibited to make rapid responses. Don't use this as an excuse though. It only works with certain personalities, and after a certain quantity is consumed there is a definite lengthening of simple RT. The degree varies with

individuals and the rapidity with which the alcohol was consumed. Each person's rate of alcohol absorption may vary considerably but alcohol burning rate is constant for a given body size. All the airlines, military and government agencies now have preflight abstinence rules, though the abstinence period varies from 8-24 hours.

Top ranking race drivers have superior to abnormally fast RT's. Though a racing driver, due to his training and alertness, may react more quickly than most drivers on the street, he does not demonstrate any neurological superiority and no correlation can be made between his driving performance and his RT capability.

Outstanding athletes exhibit superior RT capability. Outstanding athletes are often given credit for having fast reactions. To explore this possibility, RT tests were run on a cross section of athletes during and after competition. The initial results indicated that for the tests given athletes did have shorter RT's than non-athletes. A later check revealed that the shortened RT's were actually due to the competition itself. The raised body temperature and emotional and mental set of each contestant speeded up his reactions.

There are several ways to demonstrate or test reaction time. One of the simplest (and most risky) ways is an old party trick. Suspend a one-dollar bill (or more if you have confidence) from its upper edge with your fingers and challenge anyone to place his thumb and forefinger even with the bottom edge and catch it by snapping them shut when you release the bill. Since a dollar bill is six and one-eighths inches long, theoretically the sucker would have to react within 0.18 second. But if you accidently tip off the time you are going to drop it, or the bill sticks to your fingers, or he drops his hand as he snaps his fingers shut you have lost your money.

A test using numbered squares developed by Shell Oil Company in one of their safety advertisements is shown on page 51.

Anticipate responses

If you consciously place yourself in a situation where your responses must be fast and accurate, don't just assume your reactions will or won't meet up to the situation. Learn as much about it in advance as you can. Anticipate, try to eliminate the unknown and reduce the decision time by finding answers ahead of time.

RT becomes most important for people when they are driving. Do you know how quickly you can stop your car? Oh, of course, you have read the tables on speeds and braking distances but what does 50, 176, or 230 feet really look like to you? The best way to find this out is to take your car out on a large deserted parking lot, airport or road, and try stopping as quickly as you can from various speeds. You may be shocked. You may find that one

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wheel locks up, or the brakes fail. Unfortunately, for most people, they find out about this when they make their first emergency stop.

What would you do if your brakes went out completely? The correct reaction would be to try pumping them, shift to a lower gear, turn off the key to let the engine slow down the car, and try using the emergency brake. This would be a good thing to practice.

What if the car begins to skid? Do you know whether the back end or front end would skid first? Do you know how to correct? The main principle is to turn the front wheels into the skid so the back end and front end line up. To talk about it is one thing, but if possible it should be practiced.

Most drivers never prepare for an emergency by even thinking about it ahead of time. Then if it happens they are so confused and frightened they end up by not reacting at all. Anyone who has trained for a pilot's license has spent much of his training time studying and practicing for various emergencies that might occur in the air. Unfortunately, due to our present driver certification procedures, the only emergency test that is given is usually a quick stop from about 20 mph.

It appears that a majority of the drivers on the road today have only half their mind on the road—if that much. Concentrating on the driving job at hand and anticipating what is going to happen eliminates many potential emergencies.

Telephones for the deaf

by Gale M. Smith

CAN a totally deaf person use the telephone? Its inventor, Alexander Graham Bell, if he were alive today, would be pleased to know that this question can be answered with an emphatic, "Yes!"

Totally deaf people are now using the telephone with relative ease. Moreover, deaf persons without speech, and deaf and blind persons are using it too. There are simple, inexpensive telephone arrangements available to help these people, as well as more elaborate installations for those who want special features. Some of these installations allow communication with a few individuals, and others permit connection to any phone.

Basically, all that is needed to communicate with a deaf person is to use some other of his senses in place of hearing. Either vision or touch will serve the purpose.

All that the handicapped person's telephone installation has to do is to change the electrical signals from the telephone line into visual or tactile ones. There is very little choice in the case of tactile signals, but several kinds of visual signals are possible.

A visual message received by telephone may be nothing more than a series of flashes of a light, forming code symbols (such as the dots and dashes of the continental Morse code). A visual message can also be exceedingly complex; it can be two-dimensional (having width

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A deaf person connected an electronic flash to his phone. When it rings, the flash goes off and the light can be seen all over the house.

and height) or three dimensional (having width, height and depth). An example of a two-dimensional visual message is an ordinary printed page. Another example is a picture of a sound wave—of which more will be said later. The most complicated kind of visual message is called "visible speech." It consists of a series of three-dimensional pictures of the characteristics of the human voice, in which the third dimension is intensity rather than depth.

Visual or tactile messages

For a deaf person to use the telephone effectively he must be able to receive messages in visual or tactile form, not only from the person at the other end of the telephone connection, but also from the automatic switching equipment in the telephone central office. The switching machinery has few things to say, but all of them are important:

1. "Somebody wants to talk to you."
2. "I, the switching machinery, am now ready to serve you. Go ahead and dial the number you want."
3. "I am ringing the number you dialed."
4. "I can't get through to your party because all the circuits between here and there are busy. Please try again later."
5. "The line you have called is busy."

Those with normal hearing know that the switching machinery uses the familiar ringing of the telephone bell, dial tone, audible ringing signal, all telephone circuits busy signal, and called telephone busy signal, respectively, to bring the listener these five messages.

Letting a deaf person know that someone is trying to reach him is not particularly difficult. The telephone company can install a little device called a "ringing relay" which may be used for this purpose. The ringing relay is an electrically operated switch which turns on when the phone rings, and off when the bell is silent. The switch can control any electrical appliance provided by the telephone user. For example, a deaf person could connect a lamp at the head of his bed to the ringing relay. Then, if he received a phone call during the night, the lamp would flash on and off to awaken him. A floor or table lamp could be used, or a series of lights, one in each room.

At least one telephone user has connected a photographer's electronic flash to his ringing relay. When a call comes in, there is a brilliant flash of light, once every six seconds, until the phone is answered.

The flash is so bright that it can be seen in adjoining rooms, even in full daylight.

It is also possible to signal a deaf and blind person when he has a telephone call. One such handicapped person has electric fans connected to his ringing relay. Whenever he feels a breeze, he knows someone is trying to reach him by phone.

Cathode ray communicatons

A visual telephoning arrangement which has brought much satisfaction to a Bell System customer on the West Coast is a cathode ray oscilloscope—an electronic instrument with a screen like a small television set. Instead of ordinary pictures, however, the oscilloscope screen displays the shapes of electrical waves.

In placing a call, the deaf person watches the screen when he picks up his handset. As soon as he sees the continuous wave shape representing dial tone, he knows he can dial his number. After dialing, he will see another wave shape—either a ringing signal or a busy signal. The ringing signal is on for two seconds, off for four; the busy signal comes on briefly once a second. If the ringing signal suddenly gives way to a rapidly fluctuating wave shape, the deaf person recognizes that he is "seeing" a human voice. Someone has answered the telephone, and this is his cue to announce his name.

If he is calling a friend, the friend will signal to him with a prearranged code. This can be done by whistling, by humming, by tapping with a finger on the mouthpiece, by twirling the telephone dial, or by sending code with a buzzer and telegraph key. The deaf person will see flashes on the oscilloscope screen corresponding to the sounds made by the other person and can "read" the messages being sent to him.

If the deaf person is able to speak, he can converse with the other party. If he cannot speak, he can communicate by whistling, humming, using a buzzer, etc., with the same code that he employs for receiving. In Montreal, for example, two teenage boys, both deaf and with no speech are now able to telephone each other. They receive continental morse code by watching a flashing light, and send with a telegraph key. The key turns a little transistor oscillator on and off, and the oscillator makes a whistle or "beep" sound whenever it is on. The "beep" controls the flashing light, but, of course, they don't hear it.

Speech synthesizer

A big problem arises when a deaf person wishes to communicate with a stranger or with a friend who does not know the code. There's not much the deaf person without speech can do in this event, unless he can afford a laboratory wonder such as a speech synthesizer, or a computer programmed to spew out

The ultimate in communication for the deaf is "visible speech" produced by a sound spectograph, translating speech into visual symbols.

pre-recorded words when words are typed into the input.

If the deaf person can talk, all he has to do is to announce, "This is John Doe calling. I'm totally deaf. I can't hear anything you say, but I have a special telephone that lets me read code signals if you will just whistle or hum them. Hum once for 'yes,' twice for 'no', or three times for 'I don't know' to answer the questions I'm going to ask you." The handicapped person is now able to get an answer to any question which can be answered by a yes or a no.

"Twenty Questions"

Some kinds of information are not as easy to come by, and a deaf person may often find his telephone conversation turning into a game of "Twenty Questions."

We have assumed that the deaf person was using an oscilloscope. But an oscilloscope is a rather complicated looking gadget. It has a control panel covered with dials and knobs, and the user has to know how to set them properly or he won't get a picture on the screen. People who are not technically-minded may prefer a flashing light because it is much simpler.

With the simple light signal installation, a steady glow means there is dial tone. If the light flashes regularly once per second, this means the called telphone is busy. Two flashes per second show that all circuits are busy. A cycle of two seconds on and four seconds off is a signal that the called telephone is ringing. Irregular flashing means that someone has answered the call and is speaking on the line.

The experimental tactile receiver does exactly the same job for the deaf and blind person that the flashing light does for the deaf person who has his sight. It changes coded electrical signals from the telephone line into mechanical vibrations which can be felt with the finger tips. However, the vibrations produced by whistling or humming may be too weak to be detected unless amplified. For this reason, deaf-blind telephone users who don't have amplifying telephones may ask callers to dial zero once to signal "yes" and twice for "no." The resulting dial clicks are generally loud enough, on local calls at least, to be detected with the tactile receiver.

If cost is of small concern and if the totally deaf person wants to receive calls from only a few specified telephones, both rather big "if's," there are several service refinements available. The telephones involved can be equipped with Bell System "Data-Phone" Data Sets, or similar equipment

from other telephone companies, and then used in connection with teletypewriters or telewriters. Both of these machines permit the exchange of written messages.

Teletypewriter messages appear in typewriting on paper rolls. A novice can send messages on the teletypewriter keyboard by the hunt-and-peck method, and a person with a little experience can type as rapidly as 60 words a minute.

Telewriters provide for the exchange of handwritten messages. To send a message with a telewriter, you just write on a paper in the machine, using a stylus. At the receiving machine, a similar stylus reproduces the handwriting on another piece of paper. Drawings can also be sent over telephone lines in this way.

Perhaps the ultimate in communication for the totally deaf is "visible speech," a development of the Bell Telephone Laboratories in the early 1940's. Visible speech is produced by a costly and intricate piece of laboratory equipment called a "direct translator," which is basically a sound spectrograph. The translator display is complicated looking and sometimes hard to interpret. With adequate instruction, however, a person can learn to recognize visually a large number of words.

The direct translator can be used with a microphone for face-to-face gatherings, or connected to a telephone for communicating with a distant party. Special equipment is required only at the deaf person's end of the telephone connection. A deaf person with translator could receive calls from anyone, anywhere in the country. Unfortunately, though, the present cost of a translator puts it beyond the reach of most people. Up to now, at least, these instruments have been used mainly for research purposes.

Still with other, more inexpensive developments, there is little reason today for a deaf person, a deaf and blind person, or a deaf person without speech to be without telephone service.

The Andromeda Galaxy

EARLY risers who look at the northeastern sky in the coming months may be able to see a tiny smear of light that has profoundly altered astronomers' ideas about the universe.

This hazy, glowing patch is the Great Galaxy in Andromeda, an island of stars 2 million light years from our own galaxy, the Milky Way. The Andromeda Galaxy was the first galaxy ever definitely shown to be outside the Milky Way, a discovery made 40 years ago. Today, astronomers know that there are hundreds of millions of galaxies across the reaches of space. During the coming months, the Andromeda Galaxy will slip over the horizon a short time before sunrise. Each night, it will appear a few minutes earlier and a little bit higher in the sky, until by September it will be directly overhead well before midnight.

The late Dr. Tom Dooley, founder of MEDICO, at his hospital in Vietnam.

The new Tom Dooleys

THE statistics of human suffering are difficult for those of us who live in the advanced nations of the world to comprehend.

For example: Half the world's people never see a doctor from the day they're born until they die.

But, despite the enormity of just that one problem, a group of physicians, led by a remarkable man, have been moved to action. The man was the late Dr. Tom Dooley who, along with Dr. Peter Comanduras, formed MEDICO. An organization now merged with CARE, MEDICO was set up to establish hospitals and provide American physicians and personnel to staff them in the newly developing countries.

Dr. Dooley died tragically at the height of his dedicated career. But today 2,000 American doctors are serving overseas as he did, some with MEDICO and others with other private and also public agencies. Their work is only a tiny bright spot in a huge and gloomy picture of world medical care. Most of the new nations have as few as three hospital beds for as many as 10,000 people and one trained physician for as many as 100,000 persons.

Ultimately, the most important thing the MEDICO doctors will accomplish is the training of local physicians, nurses and midwives, and getting the people of these nations to accept modern techniques such as vaccination.

These pictures show how they are continuing the job that Tom Dooley started.

Dr. Robert Braden holds a child who is a patient at MEDICO hospital in Malaysia.

Although this young Vietnamese boy is smiling, he has lost a foot by stepping on a land mine. He was operated on by MEDICO surgeons at the Quang Ngai hospital.

Dr. Stan Frileck of Toronto checks the throat of a small patient at Quang Ngai. The child's stomach is distended from malnutrition, a familiar sight in Vietnam.

Dr. Pat Reardon examines the infected ear of a young patient held by his mother. Mother and child belong to the Montagnard tribe of Vietnam, a people whose villages are often caught in the crossfire of the civil war. Many war victims are treated by MEDICO personnel.

In Algiers, Dr. Allan McKelvie of the Beni Messous Hospital shows a patient who has suffered a fracture of the right femur how to operate his orthopædic equipment.

When Dr. Robert Lipe of the MEDICO team in Algiers filled out his application for service, he gave this reason for joining: "A desire to work where the need is greatest."

What's wrong with high school science

A survey of high school science teachers shows an "amazing" gap in science education. It's the fault of teachers and of the schools themselves.

by Dr. John F. Etten

THE National Defense Education Act was passed to promote better teaching in mathematics, foreign language, and science.

Parents have heard about "modern math" for some time. Many are taking courses themselves in order to understand the new approach.

They also know that in the study of foreign language, students now concentrate on being able to understand and speak a second language instead of plowing through the traditional grammatical translation method.

Is there such a thing as "modern science" in our schools?

A national study was conducted recently by the author in U. S. high schools.

Nearly 3,000 science teachers of biology, chemistry, earth science, physics, and general science responded to questions pertaining to their academic background, teaching techniques, laboratory equipment and the curriculum. The sample for the study was procured through the National Science Teachers Association in Washington, whose office identified secondary science teachers on a national geographic distribution from all fifty states.

In a day when people are encouraged to continue their formal education to gain additional skills and thus increase proficiency, it was amazing to find that many science teachers are not keeping up with their professional training.

Professional training

Regarding the professional background of the teachers, one question asked, "Do you feel you are professionally prepared in science for the latest developments in scientific discovery to adequately teach your classes?"

Twenty-seven per cent of the respondents answered, "No."

Another question asked, "What do you feel your science program needs most?" A variety of answers was elicited: "lighter teaching load," "time for more laboratory work," "more time for preparation," "specialized instructors," "more released time for planning, preparation, and research," "better teachers," "smaller classes," "students with better backgrounds in

Dr. John F. Etten is Associate Professor of Education at Chicago Teachers College North. He queried teachers in 50 states chosen by National Science Teachers Assn.

elementary school science."

The teachers' pleas for lighter teaching loads and more time for laboratory work and research seemed significant to the author. It appears that high schools are lagging badly in accepting or experimenting with popular trends of instruction. The response to questions concerning educational TV and "team teaching" indicates that there is little penetration of these new methods in science programs throughout the nation.

We read so often of the way teaching machines (auto-instructional devices) are being utilized by teachers, yet 74.3 percent or approximately three-fourths of the science teachers who answered the questionnaire do not use such equipment with their classes.

Here are three of the questions covering this area and the percentages of negative responses to them:

Question	*"No"*
Do you use educational TV in any portion of your science curriculum?	*80.1%*
Do you use the "team teaching" technique in any of your science courses?	*76.5%*
Do you use teaching machines (auto-instructional devices) in your science program?	*74.3%*

Considerable deficiencies showed up in another area. Whether he is teaching high school math, English or science, it would seem imperative that an instructor know what has been taught in the elementary schools in his particular subject matter area. He should know what plans are being made to change the curriculum. He should be aware of programs being developed throughout the country.

In the case of science, exciting educational changes are being planned. Established in 1962, the Commission on Science Education has been writing and trying out a series of science exercises for the early grades. The aim is to adopt a "process" approach rather than a "spoon fed" program of reading scientific facts. In other words, the elementary school child is to be taught by doing rather than by listening, watching and reading.

Each exercise in the sequence designed by the commission is intended as a step in the development of a child's skill in using one science process. In kindergarten through

High school math and science teachers must work together, the survey indicates, to create and coordinate a science program that's truly modern.

third grade, eight simple processes have been defined: recognizing space-time relations, recognizing number relations, observing, classifying, measuring, communicating, inferring and predicting. In brief, the "modern science" program being developed for use in the elementary schools emphasizes the introduction of the mathematical concept from a science situation in which it naturally arises. (According to the Commission on Science Education, ideas of the three-dimensional space in which we live—ideas of position, distance time and velocity—all rest upon the skills and intuitions of arithmetic and geometry.)

Now, if we cannot remove mathematics from "modern science," it would seem that teachers from both disciplines must be working together in this new science program. The questionnaire sent to high school teachers included a question pertaining to the relationship between the math and science departments:

"Are the science and mathematics departments ever brought together in planning interrelated courses?"

Fifty-five per cent of the science teachers replied, "No."

In the intermediate grades in the program being developed by the Commission, new integrated science processes are introduced, all based on previously learned skills and concepts. In 1964, the Florida State University conducted a conference in junior high school science, and this group is now at work on curriculum materials developed for use in the junior high school. They feel that true scientific literacy depends upon the student's ability to make the transition from "process development" to concept formation. Thus, the junior high program should bear a strong relationship to the elementary school science program that precedes it and the more discipline-centered high school courses that follow.

In our questionnaire, we asked the high school science teachers:

Coordination

"Does your science program coordinate well with the elementary and junior high science curriculum?"

Twenty-nine percent said, "no."

Now, what happens to the child who comes to high school with a background in "modern science" that has been based on the "process" method? What does he study in high school—the traditional science courses—physics, chemistry, biology?

If there is to be any continuity to the programs being developed for use in the elementary schools, the

same emphasis on the individual's role will have to be incorporated into the teaching of high school science courses. In high school, the student will want to discover for himself through observation and inference, something of the nature of the physical world about him. He will keep record books of his own observations—and interpretations. And, as he derives data from simple experiments in physics, he will want to tie in the mathematical concepts involved. As the students study biology, they will come to realize that mathematical computations enter into their investigations.

This survey was begun to see what new trends are developing, and to discover whether or not any actual changes in the curriculum have occurred. A study of the responses has led the writer to the following conclusions:

1. While science studies, projects, surveys and programs have been multiplying rapidly, the average secondary science teacher seems to be maintaining the status quo. The so-called new trends have at best only dented the static framework of science teaching in our secondary schools.

2. There's a gap in the communications among science teachers. More than 60 percent of the teachers involved in our survey said that meetings of the science faculty are held monthly, bi-monthly, or weekly. And nearly 90 per cent of the science teachers participated in science meetings either local or national. Yet almost one-third of the high school teachers admitted that there is no coordination with either the elementary or junior high science curriculum.

Math and science

If math and science are interrelated in the "modern science" programs, we wonder why there is a lack of communication between the teachers of science and mathematics.

3. Many teachers, if not all, are making an effort to keep up with the fast pace of science. We asked the question, "How recently has your science curriculum been changed?" Here are the replies:

61.5%	*1 to 2 years*
29.4%	*3 to 4 years*
5.5%	*5 to 6 years*
4.0%	*7 or more years*

Indeed changes have been made. Does this mean, though, that teaching has been improved?

Without long-range planning, adequate facilities or adequate personnel, the realization of basic educational goals may not have been accomplished.

"Modern science" assumes that laboratory situations are of utmost importance. Students should have courses that are largely "discovery-centered," requiring extensive use of experimental equipment in the laboratory and perhaps outside of school, with a minimum of the usual textbook information. It might have been expected there

would now be a trend toward more laboratory time. But notice the responses to our question, "What percentage of time do you spend on laboratory work with your students?"

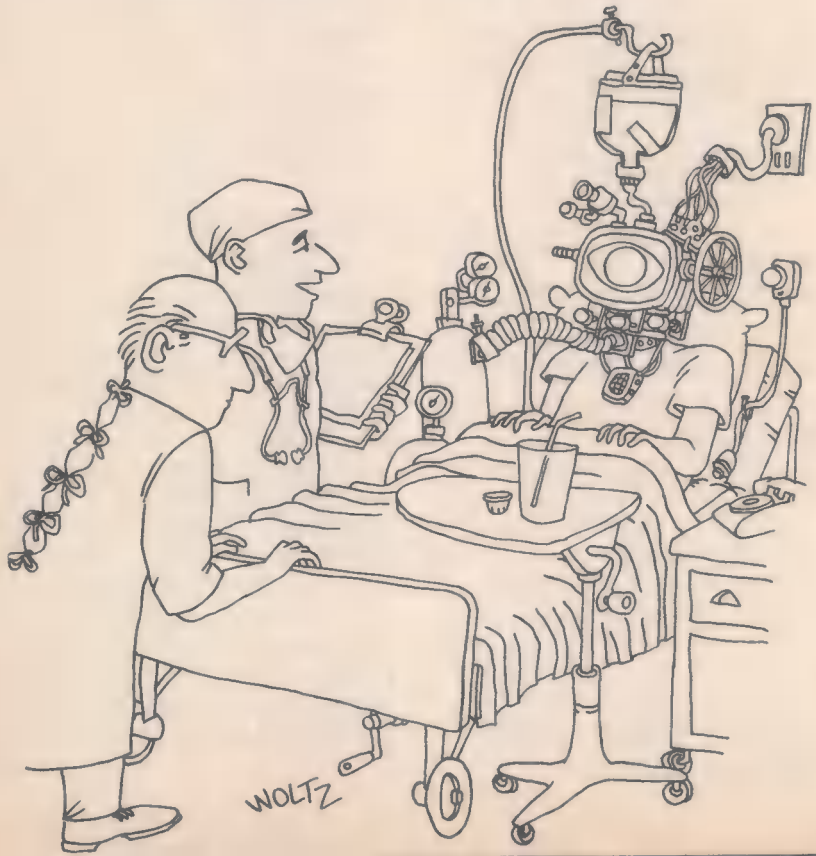
More than 80%	*1.3%*
More than 70%	*2.6%*
More than 60%	*5.9%*
More than 50%	*19.2%*
Less than 50%	*70.0%*

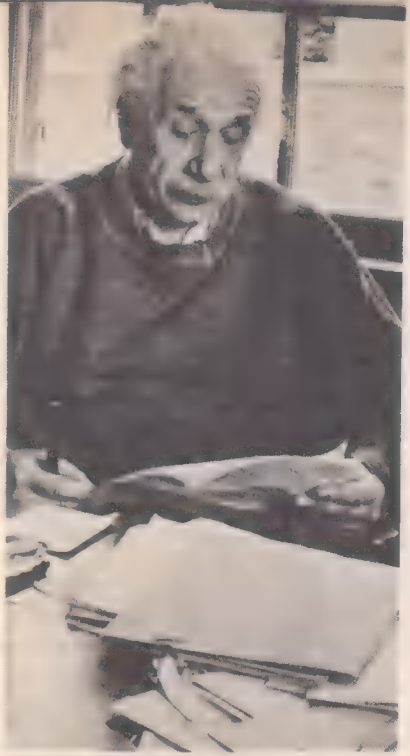
It is evident that high school science teachers are attending meetings, changing the curriculum, and keeping abreast of new happenings in the world. But evidently the teachers themselves do not think that is enough.

In answer to the question, "What do you feel your science program needs most?", perhaps the best answer came from a high school science teacher from the state of Washington, who wrote:

"More planning for today's world."

"You might as well know the truth. We had to amputate."





Alfred Eisenstadt, KFS

How to test relativity

Einstein's General Theory of Relativity has never been totally accepted. Now, remarkable experiments have been devised to test it.

by Walter Sullivan

IN 1919 an eclipse of the sun produced what seemed dramatic confirmation of Einstein's General Theory of Relativity, yet almost a half century later many scientists are not entirely convinced of its validity.

They suspect that there may be something wrong with the theory. Their doubts arise from the difficulty in making observations of sufficient accuracy to settle the matter.

Now a variety of experiments are being prepared or planned that may do so. They involve a number of extraordinary feats. One would pinpoint star locations in broad daylight with greater accuracy than has been possible at night. Another is the construction of a gyroscope that will spin for a year inside an earth satellite, shielded by supercooled, superconducting metal. A third experiment would bounce radar signals off the planet Mercury as it slips behind the sun.

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MIT scientists want to make a direct and very precise measurement of the slowing of light or radio waves by the pull of the sun's gravity.

General relativity deals with such subtle phenomena as the effect of gravity on light and the slight but significant curvature of space.

The effects of general relativity are not fully known. There are some who believe it gives us a false picture of the universe. It has been proposed, for example, that gravity everywhere in the universe is slowly weakening—a process inconsistent with Einstein's theory.

The 1919 experiment sought to test one of the predictions of general relativity, namely that the speed of light would be slowed slightly by powerful gravity. If it was slowed, its path would be bent just as light is refracted by water. This is what makes an oar seem to bend where it enters the water.

Since the sun is the most massive object in this corner of the universe, it produces the most powerful gravity. Einstein said that the light from a star, skirting the sun, would be bent enough so that the star would appear out of place by 1.745 seconds of arc.

It was assumed that such an observation could be made only during the few minutes when the blinding light of the sun was cut off by the moon—that is, during a total eclipse. Hence two British expeditions went to Egypt to observe the eclipse of 1919. They reported displacements, respectively, of 1.61 and 1.98 seconds. This was close enough to Einstein's 1.745 seconds to convince many—but not all—scientists. According to Prof. Robert T. Dicke at Princeton University, the effect is still uncertain by 10 or 20 percent, even though the experiment has been repeated during a half dozen more eclipses.

Star-measuring methods

This is largely because of inaccuracies in star-measuring methods. Various distortions by the atmosphere, telescope optics and photograph emulsion cause inaccuracies. Furthermore, eclipse photographs are taken through what is essentially a daytime atmosphere whereas the comparison photographs are taken at night, when conditions differ.

A technique has been developed that may eliminate much of this inaccuracy, for, as demonstrated in tests carried out in recent months, it makes possible the observation of stars in daylight with an electric eye. The instrument has been developed by Dr. Henry A. Hill, Associate Professor of Physics at Wesleyan University in Middletown, Conn.

Dr. Hill's sensor, whose aim at any instant can be determined with great accuracy, is swept back and

forth across the assumed location of the star. As it passes the star, its light, superimposed on the dazzling light of the daytime sky, produces a slight increase in the recorded intensity.

This system eliminates many of the former inaccuracies. It may be possible to follow a star, from day to day, as it nears the sun, thus charting the effect of the sun's gravity with unprecedented precision.

Dr. Hill's present instrument, in operation since last year, is a prototype. It may be two years before a full-fledged system has been built.

The first observed evidence of general relativity was its effect on the orbit of Mercury. Since it is the innermost planet, Mercury moves in a region where solar gravity is strong and the peculiar "distortions" of relativity are considerable. Like all orbits, that of Mercury is egg-shaped (an ellipse). Since the days of Newton, almost 300 years ago, it has been possible to explain in terms of conventional physics why this orbit does not remain fixed in space. Its low point, or perihelion, slowly migrates around the sun. However there is a component of this motion that cannot be accounted for in terms of classical physics. It is a mere 43 seconds of arc per century, but the success of Einstein's theory in explaining this extra motion in terms of gravity and curved space has played a major role in acceptance of the theory.

Professor Dicke, however, has pointed out that as much as 10 percent of this effect could be produced merely by the shape of the sun. If the sun, inside its envelope of brilliant gas, is flattened at the poles by its rotation, as is the earth, the effect could be accounted for. Such a hidden flattening would influence the shape of the visible solar disc, and Professor Dicke's group is making measurements in search of such a distortion. Until the extent of this effect has been determined, he argues, the effect of relativity can only be guessed at.

A test that can be done shortly and, it is believed, with great precision, has been suggested by Dr. Irwin I. Shapiro of the Lincoln Laboratory, operated by the Massachusetts Institute of Technology at Lexington, Mass.

It would make direct measurement of the slowing of light or radio waves by the sun's gravity.

Bounce radar signals

The proposal is to bounce radar signals off one of the inner planets—either Mercury or Venus—as its orbit carries it almost directly behind the sun. The signals should be in radio wavelengths closest to those of light—that is in thousands of megacycles. They would then travel through the sun's atmosphere at virtually the speed of light and should be effected by gravity in the same manner as light. The round trip travel time of the signals to Mercury, when its path skirts the

The most original and difficult relativity experiments would require a gyro enclosed in a super-cooled, super-conducting metal shield.

sun, should be close to a half-hour. Solar gravity is expected to slow it a mere .0002 seconds. This would correspond to an "error" in the radar distance measurement of about 40 miles. Present day electronic devices make this effect observable with an error of less than 5 or 10 percent according to Dr. Shapiro. Extended observation should narrow the margin even more.

Haystack radar

The new Haystack radar built by Lincoln Laboratory with Air Force money is capable of this experiment, but special equipment would have to be plugged into its circuits. Dr. Shapiro believes it will be a year or two before the experiment can be carried out.

The gyroscope experiment is probably the most original—and difficult—test of general relativity now being prepared. The gyro must be shielded from all external influences except those of relativity. To do this it is proposed to enclose the device in a super-cooled, superconducting metal shield. This, preliminary experiments indicate, will protect it from all external magnetism.

Under such circumstances one would expect the aim of the gyro's spin axis to remain forever fixed. However, it is traveling through space and time, and relativity says that this space-time "geometry" is curved. After each orbit the aim of the spin axis will be changed, ever so slightly. The cumulative effect, over one year, would be a shift of only about 7 seconds of arc, but it may be possible to observe this with a precision down to 1 percent.

This experiment was proposed several years ago by Prof. Leonard I. Schiff of Stanford University in California. Recently his associate, Prof. William M. Fairbanks, told the American Association of Physics Teachers of progress in building a pilot model of the device.

From the new experiments we may soon learn to what extent Einstein was right. If so, we will be closer to reality—to an understanding of how things really are and, perhaps, of that most subtle of nature's forces, gravity.

Space life detector

A NEW life detection instrument, containing an extract of the common firefly's lamp which glows when contacted by live microorganisms in space, was announced recently by NASA. Appropriately called Firefly, the instrument will determine how far out and how much life exists in the earth's atmosphere. Such data will help in exploration of other planets.

University of Wisconsin

Infant rhesus monkey clings to substitute mother of wire and terry cloth. The padded surrogate provides "contact comfort."

Why babies love their mothers

Extensive experiments with baby rhesus monkeys indicate that a lovable mother must first of all be soft and yielding.

WHAT first prompts an infant to love its mother? Many psychologists maintain that a baby's love is triggered by nursing from its mother's breast. But Dr. Harry Harlow (University of Wisconsin) thinks otherwise. For many years, the Wisconsin psychologist has investigated the development of love among rhesus monkeys, and his research indicates that a lovable

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Female langur monkeys love to hold infants, but the female who cannot keep the infant quiet is not allowed to hold it for very long.

mother must, first of all, be soft and yielding.

In one of his most famous research projects, he separated young monkeys from their real mothers and gave them a choice of two substitutes. One substitute mother was fashioned from bare wire, and the other made of wire and covered with terry cloth. Even when the wire mother did all the nursing (from a bottle strapped to the framework) the infants spent less than an hour a day in her company. Much more time, from 17 to 18 hours a day, was spent sitting on the lap of, or clinging to, the cloth-covered mother which provided, in Dr. Harlow's words, "contact comfort." In stress situations, where it was frightened by lights and oversized imitation animals, the infant always sped to the safety of the padded mother. Offering only the wire mother to a terrified young rhesus often seemed to increase its distress.

Although the padded surrogate was "soft, warm and tender, a mother with infinite patience, a mother available twenty-four hours a day, a mother that never scolded her infant, and never struck or bit her baby in anger," it was not really an ideal parent. Dr. Harlow found that while the cloth-cover mother was "biologically adequate," she was "psychologically inept." Monkeys raised with an artificial parent did not mature into normal adults.

What does a real mother supply which enables an infant to mature normally, that is lacking in a wire-and-toweling mannequin? Some insights into the maternal role have been gained through recent studies, which have provided an informative picture of what normal family life is like for wild monkeys.

Indian langur monkey

One such study was carried out by Dr. Phyllis Jay (Columbia University), who observed the Indian langur monkey in its natural habitat. While the social behavior of the langur—an arboreal, leaf-eating animal—is in many ways quite different from the social behavior of the aggressive, ground-living rhesus, Dr. Jay found that langur mothers behaved very much like those of other monkey species. "Females with small infants usually gather in groups and stay in the most protected area of the troop. . . . When the troop is at rest, females with infants sit together, and when the troop moves, they travel in the center of the line of progression, preceded and followed by adult males and females." Thus, a young langur is always in the proximity of other young, a factor which may

have considerable influence on the maturing animal. Dr. Harlow found that orphaned rhesus monkeys developed more normally if they were allowed to mature in the company of others their own age.

According to Dr. Jay, adult males in the troops she observed played no active role in the young infant's life "other than a very generalized and indirect protective one." If an older infant accidentally jumps on or bumps an adult male, she said, he gives no indication that he has even noticed the infant's presence. Dr. Jay's observations were made, however, of totally wild animals. It is, therefore, interesting to note that when the males must live under conditions of enforced "togetherness" they behave differently toward their offspring. Workers in the San Diego (Calif.) zoo report that captive male langurs seem to enjoy holding the baby.

In a paper delivered at a conference on "Relatives of Man," Dr. Jay noted that a newborn langur becomes the center of attention from the minute the females, particularly the sub-adult and adult ones, notice its presence. Almost immediately, "groups of females crowd around the mother and try to touch, inspect and hold (the infant)." Within several hours after giving birth, the mother will let one of the waiting females take the newborn from her. As many as seven or eight different females may hold the baby each day. Even during its first days of life, an infant may be carried as far as fifty feet away from its mother, who is always aware of its location, without her showing any alarm.

Females which cannot keep the infant quiet, an indication of its comfort, do not get to hold it very long. Older, more experienced females are usually the most confident with a newborn, and expend less effort keeping it calm and quiet. In addition to experience however, temperament and personality are also important factors in a female's aptitude for holding an infant. "A tense, nervous and easily irritated female frequently startles the infant with quick or unpredictable motions, whereas a calmer and more relaxed female makes few sudden movements." Some females, said Dr. Jay, are extremely inept in holding a newborn langur. They may hold it "too tightly, in awkward upside-down positions, or may insist on holding the infant away from their body to inspect and handle it."

Maternal instinct

The maternal response of females to any langur baby is apparently elicited by certain characteristics of the infant. When newborn, a langur's coat is dark brown, and as long as it remains dark, the maternal instinct will be aroused, and females will vie to hold the infant. However, when the coat turns to the adult, white color, "active female interest decreases."

The human mother whose social position insures her son a place at the top has, it seems, her counter-

part in the lower primates. Writing in *Science,* Carl Koford (National Institute of Neurological Diseases and Blindness, Playa De Humacao, Puerto Rico) explains how the social rank of rhesus mothers affects the social rank of their sons. Generally, young male monkeys "retire to the periphery of the band at about the age of puberty. These adolescents rank below the older central males." According to Koford, male social dominance—judged by exchange of threatening and submissive gestures, and by precedence at food and water—is ranked in a definite linear hierarchy, which tends to follow the order of age. However, in some bands of monkeys, he found "notable exceptions in which a subadult or newly adult 4- to 6-year-old male outranked older and larger males."

The ranking of females is not so rigid, but those with the highest rank can be discerned. In each case where a young male had risen over older and stronger males, the mother was a dominant female. None of the low-ranking males were known to have mothers of high rank. Precocious males may come to their high rank by virtue of the precedence given to their mothers and, thus, to them while they were still infants. But in no case, Koford notes, did such a young male become the leader of the troop. "High birth permits rapid advance in the social hierarchy," he concluded, "but it does not insure succession to leadership."

Studies of the mother-infant relationship among monkeys have value beyond that of discovering the nature and development of love. In the past few years, primates have become a favorite laboratory subject of psychologists, physiologists and medical researchers. Because of this demand, many thousands of these animals are being trapped each year, and the wild population of some species has been greatly depleted. Thus, there is an increasing need to breed primates in captivity. If, however, healthy and psychologically normal animals are to be raised, it is important that we understand the factors which contribute to healthy development.

Electronic traffic control

An electronic eye that looks six ways at once to regulate traffic has been installed in Hamburg, Germany. The eye, a type of radar, is used in conjunction with a traffic-light-timing computer. The radar is mounted over a busy street intersection in order to adjust the traffic-light timing for fastest traffic flow.

The number of vehicles approaching and leaving the intersection in each lane of traffic and their speeds are measured for an interval of time and the results are stored in a computer for comparison with the desired ideal traffic pattern. Changes in signal-light timing are made accordingly.

by Stacy V. Jones

How to beat the traffic mess

THE American passion for commuting by private car threatens, if unchecked, to turn the city center into a wasteland of concrete with a skyline of lofty parking garages. One way of giving the motorist his head, while preserving the urban core as we know it, would be to send vehicular traffic into midtown by tunnel and keep it underground.

The combination of subterranean highway and subterranean parking has been suggested in a private study, made by the RAND Corporation using Ford Foundation funds. Without committing itself, the Department of Commerce, parent agency of the Bureau of Public Roads, has now published the report.

The executive would drive his sedan underground in the suburbs, and leave it in a parking garage below the business district, taking an elevator up to his office. After 5

Moving and parking cars underground would be cheaper than on the surface or in the air. In New York, tolls would pay for the construction.

o'clock, he would reverse the journey.

His wife could bring in the station wagon for mid-day shopping and carry her packages out through the department store basement. Neither car would add to street congestion.

George A. Hoffman, author of the study, points out that underground garaging by itself is no answer but an added problem. There are under-park municipal garages in Boston, Pittsburgh, Chicago, Newark, San Francisco and Detroit, and New York may dig below Madison Square. These, like the many basement garages in office buildings, must all be reached from the surface.

New York and other large cities have both vehicular tunnels and underground parking facilities, but nowhere are they connected.

Although the RAND scheme has not been officially explored in this country, European planners have come closer. Stockholm has a six-lane artery below its central business district. Paris is reported to be planning some 60 lanes into its core, leading to 50,000 parking spaces. Milan intends to put all its public transportation underground by the year 2000.

Cost is a major deterrent, but Hoffman believes subterranean tunnels would be cheaper than multideck freeways above ground. In many American cities, he concludes, it may prove by the end of the century to be more economical to move and park passenger cars below the surface than on it.

$3 million per lane

Present tunneling costs are estimated at from $2.2 to $3 million per lane per mile, but advancing technology should bring these down. Boring for the parking spaces will be a bigger job than roadway tunneling. A million cars, it is estimated, would require almost 1,000 miles of three-lane tunnel for parking, plus 500 miles of approaches, distribution roads and interchanges. If in the next decade the cost of three-lane tunnels can be cut to $3 million per mile, each space could be provided for $4,500.

Construction will have to include freight-loading docks and pedestrian exits, and elevators for goods and people. Lanes can be provided for buses, so that a commuter will have a choice of his own car or mass transit. Excavated muck and rock might be turned to good account as fill material in swamps and waterways.

What about operation? The collection of toll fees can be automated. Closed-circuit television will facilitate traffic control. Exhaust

gases can be handled by forced ventilation or purified by water washing. Lighting intensity can be varied from bright near the suburban exits and parking spaces to dim in mid-route.

Murals are even suggested to relieve claustrophobia and loss of perceptual awareness—the deadening of senses that results from monotonous roadsides. Tunnel murals would demand from the artist a new command of perspective, an extension of the enormously tall lettering now used in roadbed signs.

The RAND study has an imaginative answer to the problem of policing and clearing away wrecks: overhead patrol cars with telescoping arms strong enough to pick up disabled autos.

The rescue vehicles would be suspended from electrified rails in the tunnel ceiling, and capable of high-speed travel in either direction. They would be manned by experienced policemen and equipped with ladders, stretchers, hooks and medical supplies.

Emergency crews

In addition to TV reports, the emergency crews could get signals from strips of weakly electrified metal installed along the tunnel walls two or three feet above road level. When struck by a car or intentionally short-circuited by a motorist in distress, they would point to the exact trouble spot.

Big cities, with their distinctive foundations and driving habits, present different problems. Los Angeles, for instance, moves 80 percent by car. But according to RAND, of the 1.5 million people who go to work in Manhattan (almost 1 million at the peak hour), only 5 or 6 percent now use their automobiles. Allowing for those who live in the borough, perhaps 1 million would want to commute by car if offered good roads and parking. At an average of two persons to a car, a half million parking spaces would be needed.

The total cost of a system for Manhattan, including roads and parking, is put at from $3 billion to $6 billion. The system could be paid for, says RAND, by assessing each car at about half a cent per mile driven by tube, plus $2 a day for downtown parking.

Neither the U.S. Bureau of Public Roads nor the Highway Research Board has studied the marriage of tunnels and underground parking. Construction costs would presumably be prohibitive without federal aid. A Public Roads spokesman said that, although a lot of research would be a preliminary, such financing might be worked out by the federal government and the states.

The federal share of costs is 90 percent for the Interstate Highway System and 50 percent for the so-called primary and secondary roads. In both kinds of highways there are urban sections, and the engineers have built not only elevated but depressed stretches and tunnels.

SCIENCE ABC's

Telegraph: long-distance writing

A TELEGRAPH is a device for sending information over a distance without employing a messenger. Semaphore signalling (by means of flags or wooden "arms"), and signalling by means of lamps, were used before the discovery of cheap electric current. But as soon as it was realized that the switch operating an electric lamp or an electro-magnet need not be near it, but can be several miles away on the end of a long wire, the electric telegraph was invented.

It really began when a Dr. Jackson thought of amusing the passengers on the sailing ship *Sully* with a few electrical experiments in 1832. He wound a piece of insulated wire several times around a bar of iron and showed that when the wire was connected to a battery the iron became a magnet and attracted a few nails. As soon as the current was switched off the iron lost its magnetism and dropped the nails. The iron with the coil of wire forms an electromagnet, and this had recently been invented by an American, Joseph Henry, but the idea of using it for sending messages by electricity first occurred to one of the passengers watching Dr. Jackson's experiments—Samuel Morse.

MORSE CODE

A	·—	N	—·	1	·————
B	—···	O	———	2	··———
C	—·—·	P	·——·	3	···——
D	—··	Q	——·—	4	····—
E	·	R	·—·	5	·····
F	··—·	S	···	6	—····
G	——·	T	—	7	——···
H	····	U	··—	8	———··
I	··	V	···—	9	————·
J	·———	W	·——	0	—————
K	—·—	X	—··—		
L	·—··	Y	—·——		
M	——	Z	——··		

Morse invented a simple electric switch consisting of a straight brass spring with a wooden knob on the end of it, which could be pressed by hand to make contact with a brass button. So long as the knob was held down the current continued to flow, but as soon as it was released the current was cut off. This is called a "Morse key," and it is used to send either short or long bursts of electric current through wires that may be several miles long. At the other end, the current works an electromagnet over which is a similar spring carrying a piece of iron called the "armature." During a short burst or "dot," the armature is attracted to the magnet and immediately springs back again. During a long burst or "dash," it stays in contact with the magnet for a longer time. By using a buzzer instead of a simple electromagnet, the dots and dashes can be made audible as short and long buzzes.

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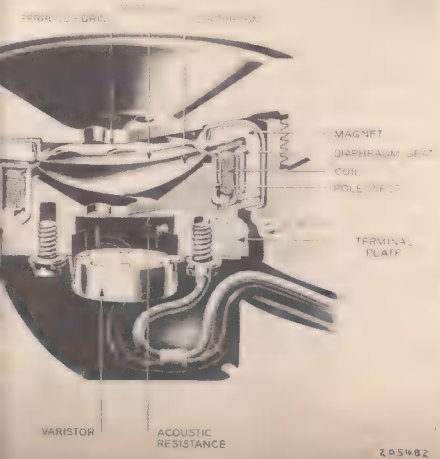
Morse devised a system of dots and dashes to represent the letters of the alphabet, so that messages could be sent over the wire by spelling them out. This system is known as the Morse code, and it is still used to send messages by telegraph.

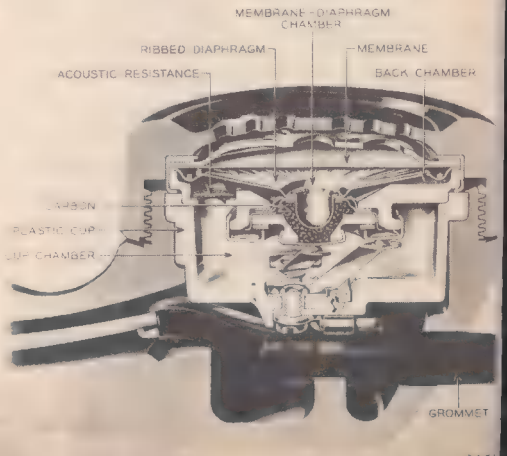
At first, telegraph wires were laid underground, but it was found that the dampness of the soil destroyed the insulation and allowed the electricity to escape. Prof. Henry then proposed to avoid the expensive insulation altogether by supporting bare wires in the air by means of poles. Such wires and telegraph poles can be seen today running beside all main railway lines. However, when the wires are very long the electricity becomes weak and has to be strengthened by means of a "relay." This receives the weak message and sends it out again on a fresh, stronger current.

Telephone: long-distance talking

The telephone was conceived by Philipp Reis in 1861, but it did not become practicable until Alexander Graham Bell improved it in 1875. Michael Faraday discovered that if a coil of wire is moved about in the neighborhood of a magnet, an electric current travels around the coil every time there is a change in the movement. This principle is utilized in the electric generator and motor.

The same effect can be produced if the coil is kept still while the magnet moves, and this was made use of by Bell in his telephone. He wound some insulated copper wire a few times around a magnet and then supported a very thin disc of sheet iron over it, so that the end of the magnet very nearly touched its center. On the other side of the disc, but not touching it, was a short "horn" into which he could speak. When he did so, the sound made the disc or "diaphragm" vibrate, and because it was so close to the magnet it caused changes in the magnet similar to those which





would have occurred if the magnet itself had moved. The changes generated little electrical impulses in the coil of wire.

The ends of the wires from the coil were led to a distant receiver or "ear-piece." This was another coil fitted with a diaphragm, exactly like the transmitter. When the electrical impulses traveled around this coil they caused variations in the strength of the magnet, which pulled this diaphragm in and out at the same rate as the first diaphragm was vibrating. If you held it close to your ear, you could hear an exact copy of the voice speaking at the other end. When you wanted to reply, you simply spoke into the same instrument, while the person at the other end listened to you. Because the Bell telephone generated its own electrical impulses, no batteries were required.

A modern telephone receiver works in exactly the same way, but an electric current is supplied because of the greater distances over which it is required to speak. A different kind of transmitter, giving more powerful impulses, is used: this is the "carbon microphone." It contains a metal diaphragm to receive the vibrations of the voice, as before, but a short distance behind it is a block of carbon attached to an immovable metal plate. The space between them is filled loosely with carbon granules. The electric current is supplied to the diaphragm and passes through the carbon granules to the plate.

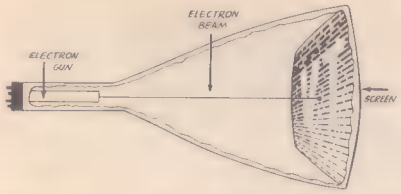
So many people have telephones nowadays that, in cities, the thousands of wires are carried in bundles through huge tile pipes laid under the pavements, and the proper connections are made at a "telephone exchange" when you dial a number or call the operator.

Television: long-distance seeing

If you hold a magnifying glass an inch or two away from the wall of a room opposite a window, you will see a little picture of a window on the wall. In an ordinary camera such a picture image falls on a film, which holds it permanently, but in a televison camera it falls onto a special screen, called a "mosaic," which converts it into electrical signals which can be broadcast.

Now, you cannot transmit a whole picture at once, for there are different degrees of light and shade in every part of it. But it is possible to broadcast its parts separately, one after the other, so that they appear in their right places in the receiver, and to do it so quickly that you see them all at almost the same time.

The first thing to do is to break the picture up into suitable parts, and this is done by the mosaic screen, which separates it into tiny dots, much as the pictures in a newspaper are made up of tiny dots (observe with a magnifying glass).



The mosaic screen is on the inside glass face of what is called an image orthicon tube. The mosaic is said to be photosensitive, which means that it gives off electrons when light hits it. The more light hitting the individual portions of the mosaic, the more electrons are given off.

The whole mosaic target gives off electrons varying in number as the light in the televised scene varies. The electron image, as it is called, is then attracted to a thin mesh frame where it is stored. A beam of electrons from the back of the tube is caused to scan over this stored image—point by point. As the beam of electrons scans over the individual points of the electron image its intensity changes, as the number of stored electrons changes. The beam now contains the picture information in electrical form that can be used by the transmitter and home television receiver.

But the signals must be sent out in some regular order, so that the receiver can reproduce them in exactly the same way, and it must all be done so quickly that we see them all together instead of one after the other. Electricity moves so swiftly that the speed presents no special problem. The entire television picture is actually transmitted 30 times every second, so that you cannot possibly tell what is happening but see the picture complete. The problem is to arrange for the globules on the mosaic to be discharged in strict order so that the signals never get mixed. This is done by "scanning" the mosaic with a narrow beam of electrons, which sweeps across it so as to draw a series of parallel lines, one under the other. The globules are thus discharged in rows or "lines," 525 lines being used in American TV.

Electron gun

The beam of electrons for scanning the mosaic is generated by an "electron gun." This beam travels in a straight line, but it can be bent by passing it between the poles of an electro-magnet.

To make the gun scan the mosaic in parallel lines two magnets are used. One causes it to move from left to right across the screen, and the other drags it downwards so that each line comes just underneath the previous line. In actual practice, the cathode-ray first draws every other line, making 262½ lines as it moves down the screen; it then starts again and fills in the missing 262½ lines. This enables the lines to be put closer together without getting mixed. The electrons discharge the globules on the mosaic as soon as they reach them, and so the globules send their signals to the signal plate at the exact rate at which the cathode-ray passes over them. They are then broad-

cast like the signals from a microphone in ordinary sound radio.

In the receiving set there is a similar cathode-ray, drawing exactly the same number of lines, in exactly the same order, as the one in the television camera. This ray strikes a fluorescent screen, which lights up when electrons hit it. This screen is made by simply coating the inside of the glass of the cathode-ray tube with zinc sulfide or some other "phosphor." Now, the picture signals are received and fed to the cathode-ray as a train of electrical impulses of various strengths. The ray thus contains more or less electrons according to the signals, and as it passes over the screen it produces different degrees of brightness according to the light and shade in the various parts of the picture which is being broadcast.

Every time the cathode-ray completes its line across the screen it is cut off—or "blanked out"—while it returns to the other side to start the next line. Otherwise you would see it streak back and the picture would be spoiled. Similarly, when it gets to the bottom of the picture it is blanked out while it streaks back to the top to start a fresh picture. These blanked-out periods are so brief that you cannot detect them, but they provide an opportunity for the transmitting station to send out a special signal called a "sync pulse," which prevents the cathode-ray in the receiver from starting its lines until the cathode-ray in the camera is ready. In this way, the two rays are "synchronized," or keep perfect time.

Peru outfishes rest of world

Of the record 46.6 million tons of fish caught around the world last year, Peru hauled in 6,901,300 tons. Japan, top fishing nation since 1948, slipped to second place, followed by Communist China, the Soviet Union and the United States. Peru is a comparative newcomer to the world fishing scene. Twenty years ago, Peruvian villagers barely caught enough to feed themselves, according to the National Geographic Society.

In 1950, several Peruvians started seining the waters for anchovetas, the three- to six-inch-long members of the anchovy family, which were ground into a fish meal, a high-protein poultry and livestock feed.

Today, fishing and fish-meal production is Peru's biggest single industry. More than a hundred processing plants grind up the catch of some thousand fishing vessels. The phenomenal growth of the fishing industry owes much to the plankton-rich waters of the coastal Peru Current. Those waters are home to an estimated ten trillion anchovetas.

Consumers of fish meal may soon include people as well as livestock. Peruvian nutrition experts already have successfully substituted the high-protein product for milk in the diets of undernourished children. Like vitamins, fish meal may well fortify breakfast cereals in the future.

The Hugh Downs Column

'Why do we have noses?'

"THE NOSE wrecks the whole face," said a teen-age girl at the dinner table.

This forthright opinion immediately touched off a discussion of the nose by the whole dinner party. The net result was that, as the teen-ager raised some profound questions, older people present (including medical professionals) gave for the most part pompous and silly answers.

I would like to set the discussion down at the risk of running out of quotation marks.

"Don't you think without a nose the face would be more wrecked?"

"Why is it nobody likes the shape of his own nose?"

"That's true. Vain people want a different shape and non-vain people think it's a silly thing to lead the whole head."

"Why do we have noses? They just get in the way of kissing."

"I think" (a pause here for two puffs on a pipe) "the nose evolved to do three things." (Puff) "First as an olfactory organ—to give us a sense of smell. Second, to filter dust from the air so a cleaner supply reaches the lungs and third—"

"Why can't we smell with the inside of our mouth and filter the air with our throats?"

"Don't interrupt your father."

"Well, he always sounds like he's preaching."

"Third," (pausing to puff four times because he's now lost his train of thought) "third, the nose—ah—warms the air, again for the protection of the lungs."

"Looked at another way, it's good to have a spare breathing intake, and this should answer your question, Joan. We'd have trouble breathing while we were eating with just the mouth and throat as an intake. You can breathe through the nose when things are calm and then if you suddenly need bigger quantities of air you open your mouth and throat."

"A horse can't do that, by the way."

"Can't do what?"

"Breathe through his mouth."

"Really?"

"Look it up."

"That's right. Close a horse's nose and he dies."

"Good heavens."

"I still think it wrecks the whole face."

"There'd be a lot fewer rich plastic surgeons if we didn't have noses, that's for sure."

"Think what it would do to the pince-nez glasses industry."

(Puff) "The noses of other primates are not as prominent as humans'." (Puff) "Apes and monkeys have nostrils of course, but very little roof structure to the nose. Ever think why?"

"Somebody ask him why or he'll be offended."

"A prominent nose offers more protection to the eyes." (Puff)

"Yes, I imagine it does. Never thought of that."

"Boy, Danny Thomas really has eye-insurance."

"Is this another example of human superiority?"

"No, almost the reverse. I think it's because in fighting," (puff) "with weapons," (busy-browed glance around the table) "whether rocks or sticks," (puff) "a blow across the face could put out both eyes if it weren't for the bridge of the nose"

"Why aren't there races of blind apes then?"

"You've been reading Raymond Dart. That we're descended from a killer ape."

"I believe it."

"Can you imagine how silly we'd look if the nose was turned around? With the nostrils up?"

"Oh, Joan!"

"It would rain in."

"That's exactly why it's not turned around. Falling objects, raindrops included," (puff) "would be inhaled."

"I'm glad nobody's writing this conversation down. Silliest thing I ever listened to."

"Can anybody give a scientific

explanation of why so many words in the English language having something to do with the nose begin with S-N?"

"How many?"

"Well, think of the words. Sniff. Snore."

"Yeah. Sneeze. Snooze. Snout."

"Snicker."

"Snot."

"Snub. Snide. Snort . . . Snorkle."

"Snoot. Snobbish. Snippy."

"I don't think 'snippy' has anything to do with the nose."

"Yes it does. A snippy person has his nose in the air."

"I think she's right."

"What about 'sneer'?"

"Good one!"

"I think she's right about snippy."

"Hey, another one: 'snivelling.' "

"Great!"

"Do you want to know why I think she's right about snippy?"

"Not particularly."

"All right. Forget it."

"No, we do want to hear. Please tell us."

"Well. The word 'snippet,' from which it's derived, originally had the connotation of diminutiveness—something diminutive. On grounds that a small person has a tendency to be feisty he's said to be 'snippy' because—"

"What's that got to do with 'nose'?"

"That's what I'm telling you. If this person is short, and sounding off, he'll be looking up. And his nose will be in the air."

(Long pause)

"That's the most unsound, unscientific and rationally shaky argument I've ever heard advanced. I think you just struck out."

"Ever wonder why in lizards and most lower reptiles the olfactory and respiratory parts of the nasal complex are very distinct, the latter being lined only by stratified epithelium unconnected with the olfactory nerves?"

"Good grief."

"You know one we forgot? 'Snarl.' "

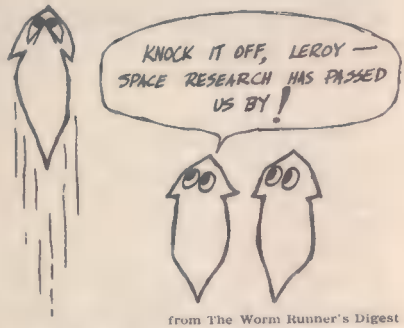
"I s'pose noses are necessary, but I still say it wrecks the whole face."

Rock collecting on the moon

COLLECTING rock samples on the moon—the major assignment of the first two astronauts who will land there—poses enormous problems, according to geologists. The vacuum in which the explorers will have to work, plus the blinding solar glare and extreme changes of temperature, will magnify the difficulties of their apparently simple task.

The astronauts may not use the usual geologist's tool—the pick—because a man who wears a space suit has poor balance in trying to bend over, and consequently poor aim. If he used a pick, rock chips could fly up and puncture the space suit. The seals of the packages for samples of rocks and other materials, as well as the tools they use, must be of a special design because ordinary tools and sealed packages come apart in a vacuum.

The funny side of science



from The Worm Runner's Digest

ONE OF the country's most widely read scientific journals is a curious publication called *The Worm Runner's Digest*, edited by a young experimental psychologist from the University of Michigan, Prof. James V. McConnell.

The title needs a bit of explanation. In psychological jargon, an experimenter who works with rats is a rat runner, one who works with insects is a bug runner. Prof. McConnell and his associates work with planarians, a common inch-long fresh-water flatworm.

The findings of the Michigan group are so remarkable and controversial (see page 20) that some years ago they began to be reported in the mass media. Soon people began writing and asking for information on the experiments. After the psychologists got tired of typing detailed replies to each letter, they decided to print up something.

Miraculously, after spending most of their time watching worms, McConnell and his friends had not lost their sense of humor and devised the journal with the strange title. ("It sounded funny to us; it still does," says McConnell.) Someone drew up a crest with a two-headed flatworm and a Latin motto which means roughly, "When I have finished explaining, you will understand even less."

"Before we knew it," McConnell says, "people were sending us articles for 'the next issue.' We hadn't planned any next issue. But all at once there was a great deal of unpublished material on hand."

That was late in 1959, and the *Worm Runner's Digest* has been coming out with regular irregularity ever since. It remains a mixture of serious lab reports and theoretical articles mixed with wild satire, cartoons and poems.

Now the best of the humor from this odd publication has been collected in a volume called *The Worm Re-Turns* (Prentice-Hall, Inc., Englewood Cliffs, N.J., $3.95).

How do scientists react to the *Worm Runner's Digest?* Says McConnell, "We've gotten in a fair amount of hot water from time to time because we gored somebody's sacred cow or because some of our peers who fail to see anything funny about anything scientific refused to take us seriously."—D.C.

One of the best bathing beaches in California is in front of the Hyperion sewage plant.

New way to clean water—and reuse it

In the future, one of the most important byproducts of a sewage treatment plant may be drinkable water.

by Priscilla Comen and Rovena Jacobson

All of Southern California is expected to figure in an explosive population increase during the next decade. Water is in short supply now. Where will the water for all these new people be found?

Experiments are under way now which may make possible the use of treated sewage water to solve the increasing drought problem.

The water table has fallen to such low levels that the wells of many coastal communities are pumping salt water instead of the fresh water of former years. Malibu, a few miles from Los Angeles, has watched its water become unfit to drink. The area is faced with water rationing. Because of the resulting severe fire hazard, the community has been denied new building permits by the county, awaiting the end of the water shortage.

Yet in the middle of this worst drought in its history, Los Angeles is pumping a river of potable water—between 100 million and 260 million gallons every day—out to sea at its Hyperion Treatment Plant in Playa del Rey. This water is as pure as that of many rivers from which some cities obtain their drinking water supply. With the new processes or even standard methods of treatment now in use, this water may soon prove vital to the solution of the water shortage problem.

The Hyperion Treatment Plant was constructed by the City of Los Angeles to treat sewage in order to safeguard the shoreline area. It is estimated that over 30 million people visit the beaches of Santa Monica Bay every year. Between 1942 and 1951 many miles of these beaches were quarantined by the State Board of Health because of unsanitary conditions caused by the disposal of unprocessed sewage.

Hyperion has improved conditions to such an extent that today

one of the best bathing beaches on the coast lies just below the plant.

Beautiful, expensive homes have been built on the hills immediately surrounding the plant. How can this be in an area that was blighted only a few years ago? A visit to the plant will provide impressive answers to this question.

The first surprise may be the size of the plant. It covers an area of 144 acres. There is plenty of room, so that it is attractively landscaped and does not spoil the appearance of the surrounding areas.

Sewage enters Hyperion, through three main sewers, flows to the headworks area where seven big bar screens with 1 inch wide openings automatically rake out the coarse debris. Then the stream flows to the grit-removing tanks. Several truckloads a day are removed, washed and used for earth fill. From here, the current runs into primary settling tanks. There are 12 such tanks, each 300 feet long, 57 feet wide and 15 feet deep. These tanks are covered by a concrete slab. In about an hour and a half, grease rises to the top and the solids settle to the bottom.

The solid matter, known as sludge, is pumped to underground digestion tanks, where bacterial action causes decomposition, then piped seven miles out to sea, to be ejected into a submarine canyon. For a short time a part of the sludge was dried and converted into fertilizer. But it cost more to process than it returned on sale, so this usage was discontinued.

Gas, produced from the sludge, serves to operate ten super-charged diesel engines, five of which drive generators supplying electricity to the plant. Surplus gas is sold to the Department of Water and Power.

The rest of the flow now goes to the secondary treatment process. Running water will purify itself,

At the Hyperion Sewage and Treatment Plant, air is bubbled through tanks of polluted water for eight hours. The brown, bubbling water has a surprisingly clean and earthy odor.

the extent to which it does so depends on the degree and type of pollution, the amount of aeration and the time involved. Air is bubbled through 32 tanks for eight hours. The tanks are uncovered, and the brown, bubbling water has a surprisingly clean, earthy odor.

Out to sea

In twenty large final settling tanks, the heavy sludge sinks to the bottom, leaving clear liquid. Chlorine is added for final disinfection, and the water flows out to sea in either the one mile or five mile outfall. The five mile outfall discharges at a depth of 200 feet, assuring the mixing of the treated effluent with the sea water. The more heavily treated outfall is pumped through the one mile outfall at a depth of forty-five feet below the surface.

This effluent is also used to irrigate all the plants in the Hyperion area. In experiments, this high mineral by-product has been found to produce unusually hardy plants.

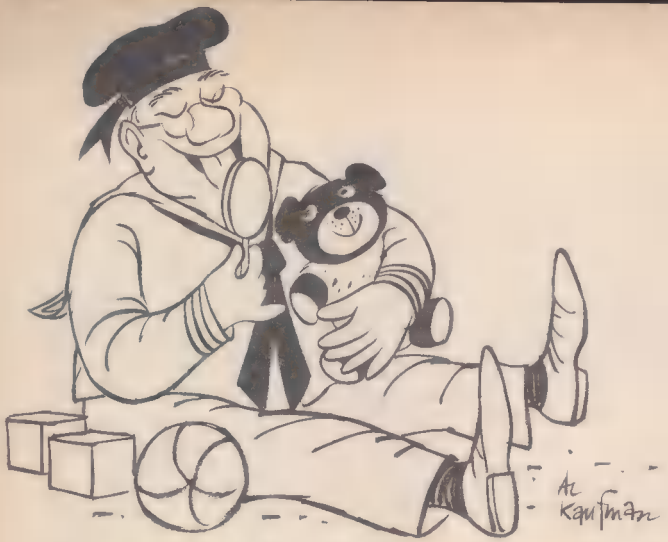
It is the mineral content that is most difficult to remove from the water. Dr. Albert F. Bush, a U.C.-L.A. professor, has started a pilot plant to reduce these. Some strains of algae will consume minerals if they can not get organic matter. Artificially adding CO_2 into the pond will hasten the process.

The cost of installation and operation of Dr. Bush's experiment will be met by U.C.L.A. It will probably run between $20,000 and $30,000 over the next two or three years. Dr. Bush is using a U-shaped pond, 200 feet long and 20 feet wide. It is lined with sheets of plastic, which will make it easy to harvest the algae.

"This process is much cheaper than trying to purify sea water," says Dr. Bush. "It can be available for use in the community quite soon. To say exactly when, however, is impossible at this point. I am sure that this is a waste resource of considerable magnitude. We must visualize a complete water management system. I think the recovered water could be used to create lakes around the Los Angeles Basin, in Santa Monica, Santa Susana, San Gabriel and San Bernardino Mountains. These lakes would be used as fire fighting reservoirs, but they could also be used as recreation areas for fishing, swimming and boating.

In a second experiment, a demonstration plant is being built in the Whittier Narrows Flood Control Basin. Here purified water will be allowed to percolate and seep underground at spreading basins maintained by the Flood Control District. As the water filters down into the subsurface basins, it will be further purified. It will join other underground water, raise the water table and eventually be pumped out through wells to be used as needed in various parts of L. A. County.

Is California's future going down the drain? Many scientists think so, and they are working today to put waste water back into the land for tomorrow's need.



Do you act your age?

by John and Molly Daugherty

A CHICAGO editor retired on a Friday at 65 and started on a new job the following Monday as public relations director for a college in the Chicago area. Aging is individual—a private affair. What do you know about age?

1. Peak performance in strenuous sports occurs about
   a. 10 years earlier than in scientific fields
   b. 10 years later than in science
   c. In the same age bracket

2. Handwriting is a complex skill you use all your life, but normally your handwriting rate as you grow older will
   a. Speed up
   b. Slow down
   c. Stay the same

3. The percentage of men over 65 earning their income in the labor force is
   a. Greater than ever before
   b. Less than in 1900
   c. The same as the beginning of the century

4. As you grow older, the sense organs that clue you in on noise, taste, odor, light, and touch have thresholds that are
   a. Higher than when you were younger
   b. Lower than when you were younger
   c. About the same

5. That women are the more durable sex, every woman knows! But do you know approximately how many widows there are for every widower? Not cutting people up into fractions, there are about
   a. 10
   b. 7
   c. 3

6. After 40 years of age, most people have some loss of hearing at both higher and lower frequencies. Experiencing such loss are
   a. Fewer men than women
   b. Fewer women than men
   c. Both sexes equally divided, approximately.

7. Up to ages 65-70, the rate of survival for white people is
   a. Better than for non-white
   b. About the same as for non-white
   c. Worse than for non-white

8. **In response to stimuli for which you have little time to prepare, as you grow older you will react**
   a. As quickly as ever
   b. More quickly
   c. More slowly

9. **When you are very old, your brain will probably weigh**
   a. The same
   b. More
   c. Less

10. **Sensory processes begin to become a seriously limiting factor in one's behavior after one has reached**
   a. 50
   b. 70
   c. 90

Answers:

1—c At about the same ages. Peak proficiency in vigorous sports and top scientific output come approximately between the ages of 25 and 35. Always remember, however, that you or someone you know may be an exception. According to research, by the time a top performer in sports is 45, he has dropped in proficiency to the level the scientist doesn't drop to until he is 70.

Choose a literary life for the longest productive span at a high level. Vocabulary and experience, the writer's tools, increase with age.

2—b Even though you've practiced handwriting all your life, you'll tend to slow down. Not only your joints and muscles, but also your central nervous system will affect your handwriting speed when you get old.

3—b The percentage is less. In 1900 about 65 percent earned their living by working. Today only one-third (approximately) of the men over 65 do. Getting income from sources other than current jobs is the trend. In the President's Council on Aging (1963), 33 percent had some earned income, as well as other income; 53 percent had only currently non-earned income.

4—a Higher. The threshold is the point at which you're first aware of stimuli. For instance, the least loudness you can hear is your loudness threshold.

If you've been shaking more salt on your food lately, maybe you're getting old! But there isn't much change in your taste thresholds until you are 50, and the change is gradual after then.

For night driving, however, you'd better hand over the wheel to your son or grandson if you're over 70. His visual acuity and reaction time are apt to be better. Even the 16-20 age group has a lower percent of accidents than the over-70's.

5—c About three at the last counting. There are about 5,000,000 widows for 1,500,000 widowers. The answer seems to be to pick your future husband from the grade school line-up when you graduate from high school—unless scientists can remedy men's lack of durability at the finish!

6—b Fewer women. Although the cause for the greater hearing loss among men than women is not known, it may be that men are exposed to more occupational noise than are women. Occupational noise over an extended period of time accounts for some hearing loss in older workers.

7—a Significantly better. After 70.

however, the survival rate for the non-white is slightly better than it is for the white.

8—c More slowly. Older people respond more slowly to stimuli not only because they're more careful, but also because, according to some authorities, there are changes in the nervous system beyond their control. Give the older person in your family a little more time to respond than you give the younger ones, and he'll come up with good answers. The wisdom and perspective he will have gained from living longer should give him a fine built-in computer, though it doesn't always operate at computer speed!

Take heart also in the fact that the nervous system may compensate for and function adequately even when a man reaches 100!

9—c Less. Gross and microscopic examinations reveal that older brains weigh less, but don't assume you're going to be light-headed!

There just isn't much evidence to prove that older people don't learn as well as younger ones. In fact, the years you stayed in school are a more important variable than your age in training for a new job.

10—b 70. If your sensory processes limit your behavior by failing before you're 70, the failure is probably caused by disease or accident, not age itself.

Men retired at 60 to 65 have gone on to second careers many times. Universities with vision often snap up professors arbitrarily retired elsewhere at 65. Even industry is beginning to recognize the wisdom in hiring experts over 65 as consultants in specialized fields. So keep searching for knowledge all your life. Don't let age stop you!

Score Yourself:

9—10 right—You're acting your age!

4— 8 right—You can still learn a thing or two.

0— 3 right—You don't have to get any answers right to live a long time!

"I wouldn't have the slightest idea what to do if it stopped running."

From the Vice President's office

The Vice President appreciates your thoughtfulness in sending the February 1965 issue of *Science Digest*. He read with deep interest the article on U.S. science and technology.

As Chairman of the National Space Council, he found other articles in that same issue of interest, too.

WILLIAM CONNELL,
Administrative Assistant
Office of the Vice President
Washington, D.C.

What an earthquake!

I was fairly well read on the damage of the Alaskan earthquake of Good Friday 1964, but it was not until I read your article *One Year Later—What Happened in Alaska* (March '65), that I became aware of the full severity of that quake. How strong it must have been to have caused the cities of Nome and Barrow to completely change locations with each other, as shown in your inset location map.

PAUL BATTERMAN
Westover AFB, Mass.

It wasn't strong enough to switch the cities, but it must have been strong enough to confuse the mapmakers.—Ed.

Round and round with Venus

In *The Solar System—Science ABC's* (March '65), you say that all planets rotate counter-clockwise. New findings show that Venus rotates clockwise.

MRS. A. HOLMES
Shaker Hgts., Ohio

We noted the new evidence on the rotation of Venus in our Nov. '64 issue, but failed to update the March story.—Ed.

Applause for Downs

Science Digest has been a constant and greatly appreciated "member" of our family for a long time. We always read it thoroughly, except for some of the technical articles on military and space exploration. We wish to complement you on its high literary quality, and your impartial, but generally ethical, treatment of ideological (philosophical) subjects. We hope you will continue this way.

I was particularly excited by Hugh Downs's article, *The Vision of Father Pierre* (Feb. '65). It comes near expressing, although in somewhat mystical terms, ideas that I have held for many years.

LIONEL W. KAYE
Custer, Mich.

I enjoyed Hugh Downs's Feb. column, *The Vision of Father Pierre*, very much. I have looked at the same forest but from a different point of view.

I believe that the direction of all life is towards a higher consciousness. I believe that the original amoeba is still alive because all cells are present-day divisions of that

original cell. I don't think man will be meddling with evolution. I believe that man is part of nature and that he is the part that created the body he is living in and will carry on the good work to the intended conclusion.

ARTHUR WHITCOMB
Portland, Ore.

I have enjoyed your publication for many years. In the last year, I have noticed that Hugh Downs, who stars in one of the few television programs I look at, has been writing a column for you.

Inasmuch as he affords me much pleasure on his program and since he seems to have a vast knowledge of science—he is over my head on most subjects and I have been a chemist for 40 years—I want to thank him for giving me so much pleasure.

CLAYTON W. BROWN
Woodbury, N.J.

Sarin, not Sabin

Rather ironic isn't it, that you should use the name of a saver of lives, Sabin, for a taker of lives, the nerve gas Sarin in *The Peril of Non-Nuclear Weapons* (March '65)? Sarin, I might add, has seven or eight code names, among which is T-144 (also German); Tabun is known as GA in this country.

A. H. ROCK
Conago Park, Calif.

Right, the name is Sarin.—Ed.

Soviet secretiveness

I notice that you have printed many articles and pictures of U.S. rockets and satellites. On the other hand, the Soviet Union is notoriously secretive about their space shots. Since they are about six years ahead of us, the secretiveness seems to be a hindrance to the scientific world. I believe this is important for Americans to know.

ARTHUR JOHN STUARTS
Philadelphia, Pa.

Teen-age support

As a teen-ager, I stand behind your article, *Teen-agers: New World Problem* (Feb. '65), and I would like to commend you on your excellent presentation of a very difficult subject.

WILLIAM SWANER
Newark, Del.

Interstellar travel

In your Feb. '65 issue, I was particularly interested in two articles, *New Evidence of Intelligent Life on Other Worlds* and *Is There a Fifth Force in the Universe?* I think that these two subjects are very important to each other. If we are to communicate with other worlds, it is necessary to have a more practical mode of interstellar travel than rocket power.

DENNIS FIETZE
Topeka, Kansas

New base

In regards to *Life at 60 Below* (March '65), the military base next to Fairbanks, Alaska, is no longer Ladd Field, but Ft. Wainwright (ARMY).

AUGUST A. MILLER
Bassett Army Hospital
Seattle, Wash.

Valley of wire

THE world's largest radio-radar telescope is working even better than expected.

Operated by Cornell University scientists, the $8.5 million telescope is located in the limestone hill country 12 miles south of the coastal city of Arecibo, Puerto Rico.

The telescope has two major parts. First is a 1,000-foot-wide wire-mesh reflector hollowed in a bowl ringed by hills. The mesh encompasses an area of 18.5 acres. Its shape represents part of a sphere, which, if continued, would have a radius of 870 feet. Suspended 500 feet above the surface, at the end of a 96-foot feed line, is the 550-ton antenna which aims the telescope.

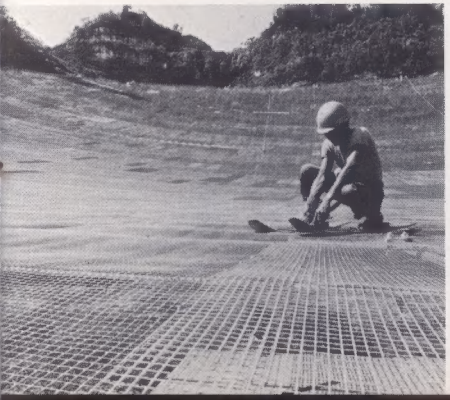
The Arecibo telescope has three major missions. First it is used for study of the ionosphere, the layer above the earth's surface that reflects radio communications. It has already discovered a type of ionospheric waves whose properties change markedly with height.

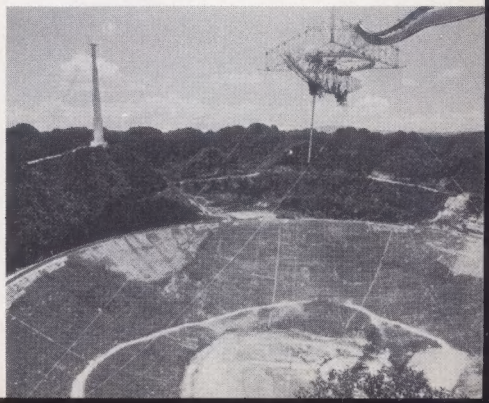
The telescope also bounces signals off planets in the solar system. The huge instrument has received the strongest signals yet sent to and returned from Mars, Venus and Mercury. The signals have shown that Venus has an irregular surface, a fact not evident through optical telescopes because of the planet's cloud cover.

As a passive instrument, the telescope receives radio signals from sources far beyond our solar system. Some of the objects emitting these signals are known as quasars, and by measuring their signals, the Cornell scientists aim to detect and catalogue many more sources of energy in space than are presently known.

This information, particularly the relation in distance among quasars, is expected to provide substance to one of two approaches to the origin of the universe: that it was born in an explosion and may so die, or that it had no beginning and will have no end.

Left: Wearing water skis to distribute his weight over the wire-mesh reflecting surface of the Arecibo telescope, a technician checks the links in the mesh. Right: Overhead view of the Arecibo telescope shows the antenna suspended above the dish-shaped reflector.

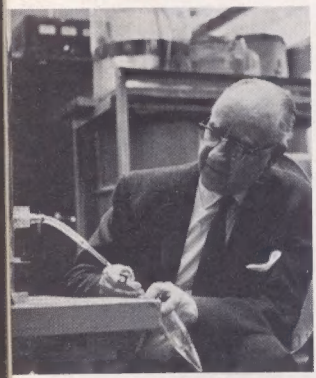




In this issue . . .

Do you want to start seeing things? Psychologists have developed a simple technique for producing hallucinations. They have also devised an unusual theory about what hallucinations are and when they occur. See page 41.

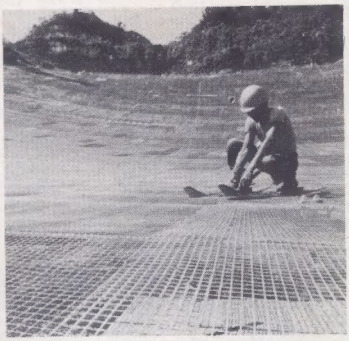
Why do babies love their mothers? Experiments with infant rhesus monkeys indicate that a lovable mother must first of all be soft and yielding. See page 73.



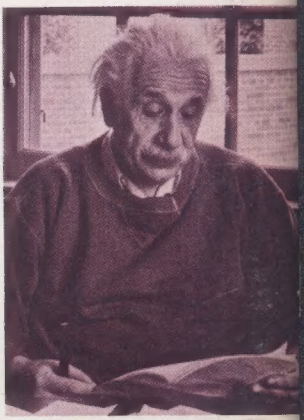
Prof. Henry Rushton has made a career of mixing. Commonplace as it sounds, it is a fascinating subject. Page 38.

News of the test of the largest rocket motor and other space advances begins on page 46.

Scientists have found that, for the planarian, two heads are better than one and a tail may be as good as a head for memory. The story begins on page 20.



In Puerto Rico, 18½ acres of wire mesh are being used to receive signals from the most distant objects in the universe. A story on this telescope is on the inside back cover.



A variety of extraordinary experiments are being devised to test the phenomena described in Einstein's General Theory of Relativity. See page 69.

You're as old as you feel, or are you? An amusing way to test whether or not you really act your age begins on page 92.